JUN 20 1921

IN THIS ISSUE:

COLORADO'S CLOUD-BURST
BRIEF FALLACIES ABOUT MONEY

SCIENTIFIC AMERICAN

JUN 20 1921
UNIV. OF MICH.

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

TESTING THE STRENGTH OF CONCRETE BY MEANS OF A SCALE AND A BUCKET OF SHOT.—[See page 486]

Vol. CXXIV. No. 25
June 18, 1921

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From a painting by Howitt showing one of the coal lines during the "shortage" when even limousines called daily for the allotted bushel. And yet the majority of people in the line were guilty of wasting tons of coal in the manner described.

This one pipe wastes enough coal to fill every basket in the line

IT isn't always coal shortage that causes sights like this—it's coal waste.

And this is what puts prices and delivery on an uncomfortable basis. For a sealing up of waste would instantly *double* America's available coal supply.

The heater that warms your cellar and not the house is taking money away from you.

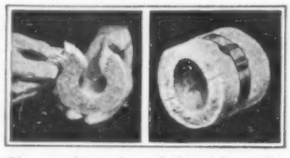
The power plants that are heating all outdoors because the covering on their pipe is faulty, physically weak and not properly installed—are burning up and wasting car after car of coal.

This deplorable condition is a hold-over from the days when covering pipes and heated surfaces simply meant putting something on them to keep some heat from escaping. The buyer neither asked for nor expected assurances of exactly how much it would save. He couldn't get them if he did ask.

So when Johns-Manville developed scientifically made and *accurately rated* insulation, engineering supplanted guesswork.

You can now know what bare heated surfaces and pipes in your home, factory or plant are costing and also to what extent the insulation you have at present is effective as a heat saver. All this has given the phrase "Heat insulation" new meaning — *assured Heat Saving.*

But if Johns-Manville had been content to stop its research after high heat savings had been achieved—as for example—in the case of 85% Magnesia, the still more desirable insulation shown in the left hand picture above would be unknown.



Showing how the felting of Asbesto-Sponge gives flexibility, so vital to long life.

Johns-Manville 85% Magnesia—the standard of the moulded class of insulations.

This type of material marks the success of an endeavor to increase the life of insulation which of course means greater economy to the user than the older molded types of material.

This material is most durable under the wear and tear of application and use. It is built up, in felted ply form and hence will not grind away under vibration, and more remarkable still—it shows the highest heat saving efficiency of all commercial materials.

Look about you for bare hot surfaces, whether pipes, flat surfaces or irregular ones, for whether they are in the home or factory you may be fairly certain that the heat they waste will soon pay for the cost of insulating them with any of these materials listed below which we will prescribe and apply for you.

Other Johns-Manville Insulations

include Asbestocel of the cellular type, Anti-Sweat to prevent condensation on cold-water pipes, Zero Insulation for cold-water pipes, Ammonia Insulation, Underground Conduit Insulation, Furnace and Boiler Insulation, and Insulating Cements.

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JOHNS MANVILLE SERVICE
COVERS THE CONTINENT

Through—

Asbestos
and its allied products

INSULATION
that keeps the heat where it belongs
CEMENTS
that make boiler walls leak-proof
ROOFINGS
that cut down fire risks
PACKINGS
that save power waste
LININGS
that make brakes safe
FIRE PREVENTION PRODUCTS

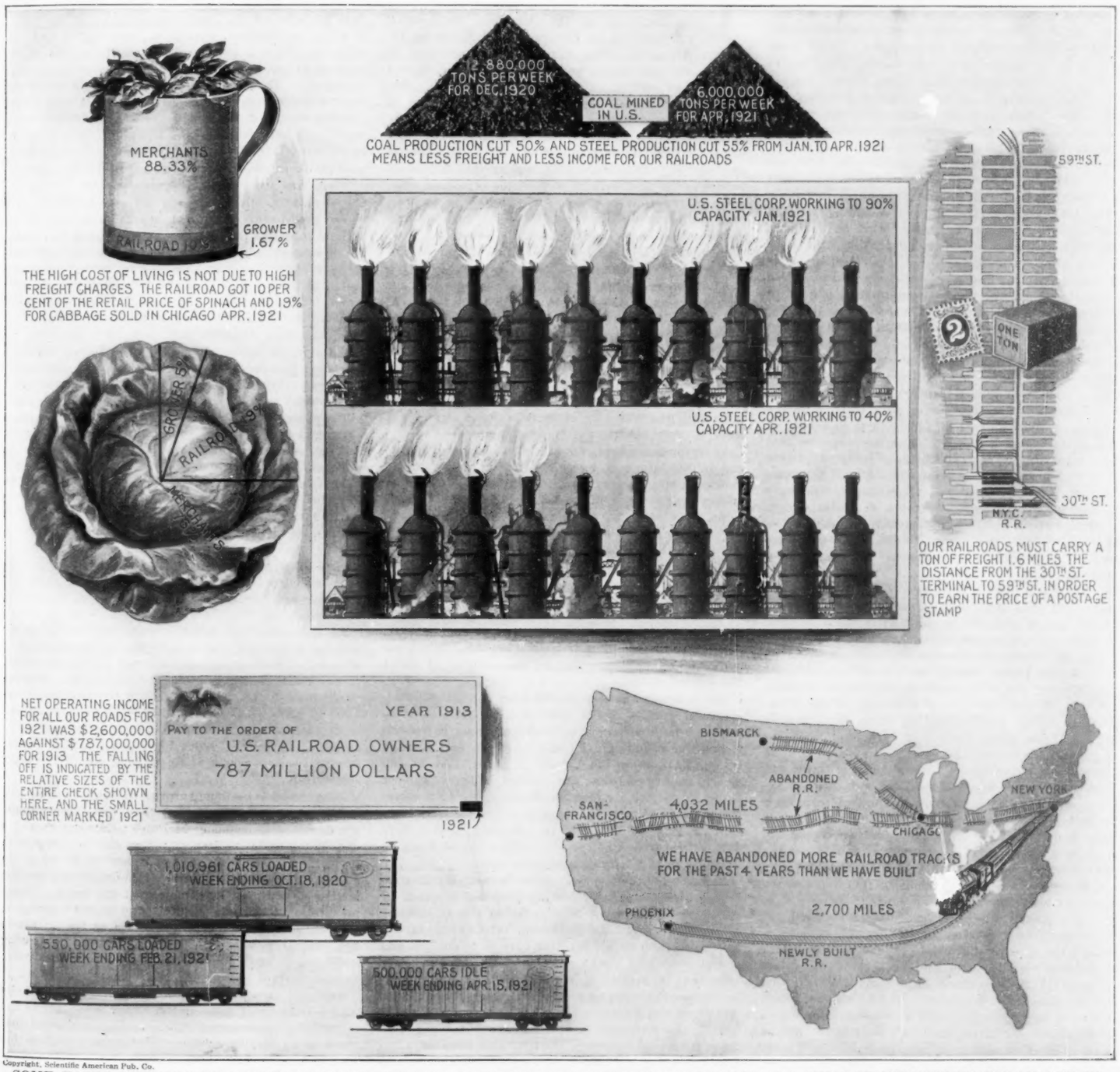
JOHNS-MANVILLE
Serves in Conservation

SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIV. NUMBER 25] NEW YORK, JUNE 18, 1921 [15 CENTS A COPY 20 CENTS IN CANADA


MERCHANTS 88.33%
RAILROAD 10%
GROWER 1.67%
THE HIGH COST OF LIVING IS NOT DUE TO HIGH FREIGHT CHARGES THE RAILROAD GOT 10 PER CENT OF THE RETAIL PRICE OF SPINACH AND 19% FOR CABBAGE SOLD IN CHICAGO APR. 1921
GROWER 5%
RAILROAD 19%
MERCHANTS 76%
12,880,000 TONS PER WEEK FOR DEC. 1920
COAL MINED IN U.S.
6,000,000 TONS PER WEEK FOR APR. 1921
COAL PRODUCTION CUT 50% AND STEEL PRODUCTION CUT 55% FROM JAN. TO APR. 1921 MEANS LESS FREIGHT AND LESS INCOME FOR OUR RAILROADS
U.S. STEEL CORP. WORKING TO 90% CAPACITY JAN. 1921
U.S. STEEL CORP. WORKING TO 40% CAPACITY APR. 1921
59TH ST.
2
ONE TON
30TH ST.
N.Y.C. R.R.
OUR RAILROADS MUST CARRY A TON OF FREIGHT 1.6 MILES THE DISTANCE FROM THE 30TH ST. TERMINAL TO 59TH ST. IN ORDER TO EARN THE PRICE OF A POSTAGE STAMP
NET OPERATING INCOME FOR ALL OUR ROADS FOR 1921 WAS $2,600,000 AGAINST $787,000,000 FOR 1913 THE FALLING OFF IS INDICATED BY THE RELATIVE SIZES OF THE ENTIRE CHECK SHOWN HERE, AND THE SMALL CORNER MARKED "1921"
YEAR 1913
PAY TO THE ORDER OF
U.S. RAILROAD OWNERS
787 MILLION DOLLARS
1921
1,010,961 CARS LOADED WEEK ENDING OCT. 18, 1920
550,000 CARS LOADED WEEK ENDING FEB. 21, 1921
500,000 CARS IDLE WEEK ENDING APR. 15, 1921
BISMARCK
ABANDONED R.R.
NEW YORK
SAN FRANCISCO
4,032 MILES
CHICAGO
WE HAVE ABANDONED MORE RAILROAD TRACKS FOR THE PAST 4 YEARS THAN WE HAVE BUILT
PHOENIX
2,700 MILES
NEWLY BUILT R.R.

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SOME FACTS AND FIGURES THAT DEMONSTRATE THE RELATIONSHIP BETWEEN OUR RAILROADS AND OUR INDUSTRIES TODAY AND IN THE RECENT PAST, AND THAT SERVE TO INDICATE THE PLIGHT OF OUR TRANSPORTATION SYSTEMS—(See page 484)

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The Peril of Floods

THE disastrous flood of the Arkansas River with its accompanying loss of life and property, particularly in the city of Pueblo, is one of those calamities of Nature's making, against which we can never hope completely to safeguard ourselves, except at enormous inconvenience and expense. There is no mystery about the causes of such floods. They are to be found in the configuration of the terrain coupled with a heavy rainfall, of unprecedented duration and wide area, falling upon thoroughly dried-out ground. In the Arkansas flood, before any considerable absorption of the rain could take place, it had swept, practically undiminished in volume, into the Arkansas River, which, no longer confined to its banks, poured in a valley-wide torrent through the devastated area.

The Arkansas is a river which is contained between high banks throughout the greater part of its route, and when the mass of water, flowing off with great rapidity from the mountains and upper regions of its watershed, reached the open valley in which Pueblo stands it encountered the backwaters from a flood of the Fountain, a tributary river, which unites with the Arkansas at Pueblo and was itself heavily flooded.

To the meteorologist and the engineer, there is nothing mysterious about such a flood as this. It is well understood that an enormously heavy precipitation covering a wide area of a watershed, particularly where the topographical features are similar to those in the Arkansas watershed, will inevitably produce a flood of great magnitude. Fortunately, the records show that while any such river is liable to regularly-recurring floods which are not dangerous to life and property, floods of greater volume and accompanied with some destruction occur only at intervals of ten to twenty or thirty years; while such an overwhelming flood as this, according to one of our leading hydraulic engineers, is not likely to occur more than once in a thousand years.

It is possible absolutely to prevent disasters from a flood of this magnitude only by ceasing to build towns, villages and farmhouses in the bottom lands or upon the banks of such a river as the Arkansas. This, however, would involve the abandonment of the most fertile lands of the valley, which, because of their alluvial deposit, are richer in the bottoms than on the foothills. But this, in the case of many valleys of the West, would mean the abandonment of these districts altogether. Cities, again, have ever been built upon the rivers, and the farmer has ever chosen his farm from the rich soils of the bottom land; and this selection will continue to be made. Not even the eruptions of Vesuvius suffice to drive the thrifty husbandman from the lower slopes of that mountain. Human nature is easily forgetful of calamities, and is always ready to purchase a present gain at the risk of future penalty. Nor is devastation such as that in the Arkansas Valley a sufficient reason for abandonment: First for the reason, as given above, that the possibilities of a repetition of a flood of this magnitude are extremely remote; and secondly because it is possible, by the erection of dams in the upper watershed, to provide storage basins of sufficient magnitude to hold back the flood waters and prevent their pouring in one great devastating rush through the valley below. The provision of such regulating works, coupled with a proper reinforcing of the banks of the river at certain strategical points, would render impossible a repetition of the Pueblo disaster. The great flood in Ohio several years ago was broadly similar in its causes and effects, and the regulating works which have been subsequently built have relieved the residents of Dayton, Ohio, from fear of any repetition of the disaster of 1913.

Great as is the Pueblo disaster, with its many dead and a property loss of fifteen to twenty million dollars, previous floods have greatly exceeded these totals in the total damage done. Thus the Dayton flood cost six hundred lives and three hundred million dollars in the state of Ohio alone, and the Mississippi flood of the year before produced a property loss of between eighty and eighty-five millions. Every state in which floods of great magnitude are liable to occur should follow the plans laid down by the Pittsburgh Flood Commission, a highly technical body, which called for the construction of storage reservoirs, the improvement of river channels, and the protection of banks by well-known and proved methods.

Enormous Waste In Industries

THE committee which was appointed by Herbert Hoover, now Secretary of Commerce, when he was chairman of the American Engineering Council's Committee on Elimination of Waste in Industry, has made public a report which, because of its valuable and highly authentic information, should be read and studied by capital and labor alike. The startling and almost sensational facts and figures of the report must not be allowed to throw any doubt upon its truth. The habits of careful and exact thought which characterize an engineering body of this quality preclude any suspicion. This inquiry into industrial wastes is the first definite step of the organized engineers of the United States, some 200,000 in number, to secure better industrial conditions and promote harmonious relations between capital and labor.

A summary of the report shows that the margin of unemployment is more than a million men; that billions of dollars are tied up in idle equipment; that the most frequent cause of waste is high labor turnover; and that millions are annually wasted in loss of time and capital through duplications, estimates and bids in the building trades. The charge is made that the employer as well as the employee restricts output; but although both capital and labor are guilty in this respect, it will come as a surprise to the public to learn that the waste by conflicts between capital and labor is much less than is popularly supposed.

As to unemployment, we are told that from four to five million workers were idle during January and February of this year, and that in 1921, 500 million dollars will be lost in wages in the building trades alone.

On the question of preventable disasters and death, the committee states that the annual economic loss to the country from this cause amounts to three billion dollars. It asserts that 75 per cent of the deaths and serious accidents in industry could be prevented by a more general use of safety methods which have been perfected and proved. We are told that in 1919, there were three million industrial accidents which resulted in an economic loss to the country of about 850 million dollars.

The printing industry should take note of the fact, according to this report, that an investment of more than 100 million dollars in stocks of paper carried to meet trade requirements could be cut in half through standardization in the brands of paper. As to efficiency, we are told that the building industry is about 60 per cent efficient; that the waste in the shoe industry is about 35 per cent; and that in the ready-made clothing industry it should be relatively easy to save $375,000 every day of the year, which would mean an increase of 40 per cent in effectiveness.

So much for the disease. As to the remedy, the committee lays down the following proposed program by which the Government may assist in the elimination of waste: A national industrial information service to furnish information covering current production and consumption and stocks of commodities should be established; a statistical service covering employment requirements should be set up; the Government should encourage and foster a national policy regarding public health; those who have physical defects and have suffered industrial accidents should be assisted by a national program for industrial rehabilitation; a nation-wide program of industrial standardization should be encouraged; the Government should revise such Federal laws as interfere with the stabilization of industry; and, finally, a body of principles should be accepted which could be developed for the adjustment and settlement of labor disputes. All of these are excellent recommendations which should commend themselves to the thoughtful consideration both of Congress and of the people.

Rolling Reduces Speed at Sea

TO most of us mortals the thought of a ship rolling heavily in a seaway serves to bring a twinge of unpleasant memories or a shudder of dire foreboding—just that, and nothing more. But at the last meeting of the Society of Naval Architects and Marine Engineers in this city the question of the rolling of ships was viewed from the very practical angle of the serious retarding effect which rolling has upon a ship, and the great increase in power which is necessary if the speed is to be maintained. The discussion was based upon a paper by Commander William McEntee, of the Construction Corps of the Navy, in which he gave the results of comparative tests of bilge keels and a gyro-stabilizer, made in the Navy tank on a model of the United States aircraft carrier, "Langley." The "Langley," a 520-foot ship of 11,000 tons' displacement, has been reconstructed as an airplane carrier, and since airplanes are intended to take flight from her deck and land thereon after a flight, it is, of course, highly desirable that her deck, considered as a platform, should be rendered as stable as possible.

There are two ways of preventing the rolling of ships—namely, bilge keels and the gyro-stabilizer. In these experiments, artificial waves were produced, while a model of the "Langley," 23 feet long and capable of supporting a dozen people, was towed down the tank, while rolling was produced by setting up wave action in the tank. The model was tried first in still water, with bilge keels, and then with the bilge keels removed and the stabilizing gyro in place. We are told by Commander McEntee that without bilge keels, in still water, the model after being keeled over, required 54 swings to reduce the angle of heel from 11 degrees to 3 degrees. When the bilge keels were in place, only eight swings were necessary.

The model was next rolled with and without bilge keels, and then with the gyro-stabilizer, all three tests being made amid artificial waves. For this purpose it was held broadside to the waves by single head and stern lines, made fast to the model at the waterline close to the longitudinal rolling axis. The bilge keel reduced the arc of the roll from 26.4 degrees to 9.6 degrees, whereas the gyro-stabilizer reduced it very quickly from 34 degrees to 3 degrees. The results of several other tests were given in the paper, and they all demonstrated the, we had almost said, uncanny, way in which the gyro-stabilizer damps out the rolling of a vessel.

Another important point brought out in the paper was the increase of towing resistance of the model if it were rolled while it was being towed in smooth water. It was found that at a speed of 15 knots, the effective horsepower of the "Langley" would be increased from 3,000 to 3,300 when the ship is rolling through an arc of 25 degrees, and to 3,600 when she is rolling through an arc of 45 degrees, which corresponds to an increase in effective horsepower of 10 per cent and 20 per cent, respectively.

We confess to no little surprise at these figures; but, coming from such a source, they are incontestable. Furthermore, Commander McEntee points out that this does not include the loss of power due to decrease in propeller efficiency for a twin-screw ship, when, in rolling, the propellers alternately approach the surface if they do not actually come out of the water. There must also be yet another loss, due to the yawing of the ship and the resulting resistance as the rudder is put over from side to side to correct this. Yawing could not occur in the model, since the tow lines were sufficiently taut to keep the model on a true course.

Just how great the loss through free use of the helm may be was dwelt upon by Mr. Elmer A. Sperry in the subsequent discussion of the paper. He calculated that there is about 17 pounds per square foot retardation with the helm only three degrees over. Presumably, his figures are for the "Langley," but for what speed he did not state. Everybody will agree with him, however, that when a ship is rolling heavily, the busiest man of all is the helmsman.

Electricity

A Daily Market Report prepared by the U. S. Bureau of Markets is being sent out by radio from the laboratory of the Bureau of Standards at 5 P. M. each day except on Sundays and holidays. This report, known as the Daily Radio Marketgram, is about 500 words long.

Welding with Two Arcs in Series. — In a recent issue of *L'Electricien* there is outlined a scheme by means of which it is feasible to connect two welding places in series, both being fed from one direct-current generator. Two contactor relays and two substitute resistances are necessary to permit the two welders to operate independently of each other. In case one of the arcs goes out the relays cut into the circuit the substitute resistance, which is short-circuited when both arcs are in operation.

Radio in Indo-China.—It has been decided to utilize radio telegraphy as a means of communication between Saigon and Hanoi. The submarine cable which connects Cochin-China and Tonkin is subject to frequent breakage, the cost of repairing which entails greater expense than the credits allowed, and for lack of credits it has been impossible to repair a breakage which occurred in October, 1919. However, in order to assure continuity, permanence, and the regular service of telegraphic communications, the Governor General of Indo-China considers the employment of the coast cable as still necessary, and he proposes to assure all the expenditures entailed for the latter out of the budget of the colony.

Improvement in Cavite Radio Station.—Recent improvements in the naval radio telegraph station at Cavite now enable the transmission of radio messages from the Philippines to San Francisco without relay. A large increase in electrical power and the construction of telegraph lines between Cavite and Los Banos are responsible for this direct Pacific radio service covering some 7,000 miles. Formerly dispatches from the islands to points in the United States were copied at Honolulu and relayed to the mainland. This meant unnecessary delay in transmission. The improvements will treble the capacity of the Naval radio service to and from the Philippines. The Naval radio station at Cavite and Los Banos are handling a daily total of approximately 12,000 words.

The Shanghai Radio Station.—Under an agreement with the Government of China, the Federal Telegraph Company, an American concern, will very shortly commence the erection of a radio telegraph station at Shanghai larger, it is said, than any now in existence. While the kilowatt capacity of the station is the same as that at Bordeaux, France, this new station will have six masts, each a thousand feet high, whereas those at Bordeaux are only 826 feet in height. The station is to be completed within 18 months and will have sufficient capacity to transmit and receive messages across the Pacific without the necessity of relay. The company will also erect other stations at Peking, Harbin, and Canton, which, together with the Shanghai station, will give China unexcelled wireless facilities.

Electrification of Jamaica Railroads.—At the request of the Jamaica Imperial Association, the Jamaica Government two years ago voted £1,000 for investigations of the possibility of electrification of the Government Railway. This forms the only means of transportation across the island, either for passengers or for freight, except by truck and wagon on the public roads. One branch runs from Kingston in a roundabout way to Port Antonio on the northeast, a distance of 75 miles. A second branch runs from Kingston to Montego Bay, on the northwestern corner of the island, a distance of 112 miles; while a third short branch completes the total mileage of 197 miles. Since this railroad is entirely dependent upon imported coal, which is very expensive here, the authorities have desired to make use of the water power on the island.

How Glasgow Saves Current.—Folks who believe hustle and bustle in everyday life is a characteristic confined strictly to the Western Hemisphere would do well to visit Glasgow, according to an engineer writing in *Electrical Review*. "In all the time I was in the busy Scotch metropolis," states this engineer, "I never saw a streetcar stop at any but few stipulated stations. At all other places the motorman merely reduces the speed of his vehicle when he is hailed by a prospective fare and the latter makes his ascent to the platform on the fly. Men and women, young and old, have become so used to mounting the cars while they are in movement that the latter seem to be in a state of perpetual motion at all times." Obviously, such a practice saves considerable current in the course of a year, which may have appealed to the Scotch thrift.

Science

The "Roar" of an Ostrich.—A lecturer at the London "Zoo" said that very few people knew that an ostrich roared. The roars of an ostrich and a lion were so alike that Dr. Livingstone could never distinguish the difference, save by the fact that the bird roared by day and the lion by night.

Darwin's Son to Visit Us.—After the experiences of Dr. Einstein and Madame Curie, Major Leonard Darwin, fourth son of Charles Darwin, who is to visit us this summer should come incognito or he will be killed by kindness and the reporters. Mr. Darwin is an eminent scientist, his specialties being geography and eugenics.

Palestine Chariots.—Dr. Clarence S. Fisher, curator of the Babylonian section of the University of Pennsylvania Museum, will undertake what he described as one of the most important excavations ever made in the Holy Land and the first since the beginning of the World War. He expects to find among other things some of the iron chariots mentioned in the Bible which prevented the children of Israel from capturing Bethshan, near which city some of the greatest battles of early history were fought.

X-Ray Dangers Beyond the Laboratory. — A paper presented to the Paris Academy of Sciences recently maintained that X-rays are not only capable of injuring those actually working with them, but also of penetrating the walls and ceilings of buildings and becoming a source of danger to neighbors. The writer presenting the report, who is a doctor, advised covering the walls with lead in order to protect those who, in spite of themselves, are daily exposed to this real danger.

The John Fritz Medal to be Taken to England.—The engineers of America will send a deputation to England to carry and witness the award of the John Fritz medal to Sir Robert Hadfield at the meeting of the British Institute of Civil Engineers on June 29th. The deputation to England will consist of a representative of each of the four Founder Societies represented on the John Fritz Medal Board of Award. The medal was awarded to Sir Robert this year because of his invention of manganese steel.

Lightning Zones.—The timeworn theory that "lightning never strikes twice in the same place" has been modified by forest experts of the United States Department of Agriculture to this extent: Lightning very often strikes in nearly the same places. It has its zones, in other words, where its appearance may usually be counted on with each electrical storm. With the accumulation of data on causes and locations of fires in the national forest, these lightning zones could be mapped out and protective measures introduced—such as fire lines, regulated grazing and cleaning out of dead trees—which would more or less automatically control lightning fires at the start, the foresters believe.

Elephants Raid a Railway Station.—We are used to stories of how an elephant occasionally upsets a circus but it is rare we hear of an orgy of destruction like that which occurred in the Malay Peninsula. A herd of wild elephants attacked a railway station, pulling down the station-master's kitchen and bathroom. They did the same to the clerk's quarters and then tackled the station while the office force looked on from trees. One elephant took off an automatic weighing machine as a souvenir of the raid, but finding it heavy, threw it down on the track. One of the elephants trumpeted the recall and they all went back into the jungle except one who fell in a well and had to be cut out by human aid, but was not detained. By the time help arrived after a general telegraphic alarm the huge beasts had entirely disappeared.

Human "Trimmings."—A curious case in the courts in New York was recently withdrawn before trial. A doctor used part of the patient's "left over" or anatomical debris to graft on another patient. The counsel for the New York State Medical Society said that although the question whether the detritus after an operation was the property of a patient and whether he could get damages because some of it had been used remained undetermined. He thought that analogous decisions would indicate that any individual might have the right to direct the disposition of any part of his body and that because abandonment was one method of disposition of property recognized by law, it would appear that unless some disposition actually was directed, the patient might be said to have legally abandoned parts necessarily or incidentally removed during an operation. Hence, he believed in the absence of a definite disposition that no damages could be got because such parts were used in an operation on another patient.

Industrial Efficiency

Chinese Flour.—At a time when there are so many appeals for funds with which to purchase flour for shipment to the Chinese famine victims, it is rather unbelievable that in normal times China produces sufficient flour for export purposes. Yet in 1920 almost 6,000,000 barrels of Chinese flour were shipped to Europe. New mills are contemplated in the wheat-growing sections.

Oil and New Railroads.—Until it has been shown conclusively that oil does exist in paying quantities nearer to present transportation lines, railway transportation to the Fort Norman oil district will not be provided, according to D. C. Coleman, vice-president in charge of western lines of the Canadian Pacific Railway. Mr. Coleman states that geologists have declared that there is no reason why oil cannot be found in paying quantities in other regions of Alberta, and that this has been borne out by the fact that oil has been discovered recently near the Montana boundary.

From Pimento Oil to Vanillin.—The Department of Agriculture in Jamaica, after months of experiments, claims that an important trade secret has been solved. During 1920 a small beginning was made by the Department in the production of pimento oil in the hope of extracting vanillin. The first output of pimento oil was sold in England to manufacturers of vanillin at 10s. per pound. Experiments have since resulted in the conversion of pimento oil made at the Government Laboratory into vanillin, but the researches have not as yet been completed, for the present yield is only 50 per cent of what should be produced. It is confidently expected that this difficulty will be overcome.

Australian Artificial Veneers.—A recent Australian invention of an artificial composition similar to veneer should be of interest to manufacturers in proximity to large supplies of waste material of vegetable origin, such as sawdust. As patent applications are pending in Australia and other countries, the inventor is at present reticent in furnishing details other than that the substance is worked up entirely from waste fibrous products and other vegetable matter, and that sawdust can be utilized in considerable quantities in the manufacture of the cheaper grades of the composition. The substance can be used for a variety of purposes, such as chair backs and seats, furniture generally, veneers, and wall and other paneling, and can be produced to represent excellent marble effects. It is capable of being bent freely for a variety of commercial purposes, worked with tools, sawn, bored, sandpapered, and so on, and will take nails with ease.

Work for British Unemployed.—The British Ministry of Labor states that there are now 17,000 men at work on the new arterial roads; in addition, at least an equal number, over and above those ordinarily employed on such work, have found employment on the program of road maintenance and repair work. Work has been accelerated on the layouts and sewers of housing schemes to employ an extra 4,000 men. The Office of Works has put in hand decorating and repair work in Government departments with a view to absorbing painters and similar work people unemployed to the number of 2,600. The short-time system which has been introduced into establishments under the control of the Admiralty and the War Office has resulted in the employment of 8,059 men. Further, alternative work in various Government industrial establishments has been provided for 7,994 men. Grants have been authorized in the case of some 110 local authorities for the purpose of commencing approved works of public utility, and it is expected that the schemes sanctioned will give employment to 19,955 men.

New German Metallurgic Processes.—The attention of metallurgists is being attracted to a process recently invented in Germany which, it is declared, furnishes a simple, rapid, and effective method of separating alloys into their metal components and extracting metals from mineral ores. This process is said to present many advantages over the hitherto employed method of melting alloys and separating the metal components. According to this process the metals treated with the catalytic agents go into solution in a very short time, the treatment of big blocks of metal being effected in less than 30 minutes. Out of the solution thus obtained the various metals are dissected by the employment of simple methods of chemical reaction, which permit the retaining of the metals one by one. The product first obtained is in the form of a muddy sediment which, after being dried, yields a metal powder ready to be used or melted in crucibles, or to be treated by electrolytic process. Metals and concentrated ores can be treated in the same general way, although they require one or two more operations than pure metal alloys.

What Is the Trouble with the Railroads?

An Analysis of the Business Done by Our Transportation Systems, and the Rates They Are Charging for It

By Charles Frederick Carter

IN attempting to diagnose the lamentable state of the railroads so many ailments are apparent that the investigation must end in bewilderment and dismay unless it be confined within narrow limits. Avoiding controversial subjects, which include the graver aspects of the case, it seems obvious that the trouble with the railroads is deflation.

We may speak of deflation in surgical vernacular so far as it has affected the railroads: "The operation was a brilliant success but the patient died."

In order to understand how thoroughly traffic has been deflated it is necessary to review briefly recent performances of the railroads. In 1918 when the railroads were under Government management the freight movement for the year was 437,000,000,000 net ton miles, the greatest in history up to that time. The average load per car, 29.2 tons, was the highest ever achieved, the average train load, 681 tons, was also the largest up to that time. A new high record for cars loaded, 54,980 for the last week of September, was also established. Altogether the performance was wonderful. Comparing 1918 with previous history, the record of 1918 seemed a vindication of the views of those who advocate Government ownership.

Copyright, Kadel & Herbert

Idle equipment at the New York Central yards near Kramer, N. Y. Because of the high cost of each of the locomotives and box cars, this represents a lot of invested capital that is earning no return

However, events soon proved that even under Government operation railroads cannot haul freight that does not exist. Cars loaded in the first week of March, 1919, while the roads were still operated by the Government, totaled 675,704, a decrease of 316,704 or 32 per cent from the peak in 1918. Net ton miles for the year 1919 aggregated 393,634,000,000, a decrease of 43,316,000,000 ton miles. The average load per car decreased to 28 tons, a marked slump in efficiency.

In March, 1920, the railroads were restored to their owners, under proper safeguards to prevent them from getting rich too quickly but still with many misgivings. Thus the owners had control of their properties for only three-quarters of the year and that fraction included the outlaw switchmen's strike in the spring which seriously interfered with traffic. Yet, thus handicapped, the owners set a new high record for volume of traffic handled in 1920 with an aggregate of 445,975,000,000 ton miles, an increase of 8,975,000,000 ton miles above the previous high mark. The greatest freight movement in history was August, 1920, when the movement amounted to 42,656,000,000 ton miles, earnings on which were $555,000,000. The greatest number of cars ever loaded in a single week was 1,010,961 in the week ending October 18.

New records in efficiency in many ways were also established. The average load per car was 29.4 tons, the highest yet achieved. The average train load was 728 tons, or an increase of 10 tons above the highest average previously attained. If 1918 was a triumph for Government operation, 1920 was at least an equally convincing argument for the superiority of private operation.

Unfortunately for all of us the wonderful achievements of last fall were not to be continued. The decrease in the volume of traffic since October has been the greatest known. It has surpassed that following the panic of 1907 as well as that following the end of the war in 1918. Freight revenues dropped 33 per cent from October, 1920, to January, 1921; and declined still further to 36 per cent in February. Car loadings for the week ending February 21 showed a decrease of no less than 45 per cent as compared with the high record for the week ending October 18. For the first quarter of 1921 cars loaded decreased 1,616,013 as compared with the corresponding period of 1920, according to the weekly statement issued by the car service division of the American Railway Association. The number of cars idle during the week ending April 15, 499,479 was the largest ever recorded. Under such circumstances it is small wonder that the railroads should have found it necessary to drop 300,000 men from the pay roll.

If it is true that misery loves company it should be a great comfort to know that the woeful plight of the railroads is not peculiar to the United States. No less than 54 per cent of Canada's 40,000 miles of railroad failed to earn operating expenses in 1920; but 9 per cent did earn operating expenses and also the interest on some major securities, but nothing at all for dividends. Altogether the Canadian railroads, of which 52 per cent are owned and operated by the Government, have amassed a deficit of $140,000,000, equivalent to $17.50 per capita. That rate applied to the population of the United States would give us a deficit of $1,837,000,000 instead of only $1,200,000,000, which is the present estimated cost of our little experiment in Government operation. Operating expenses for the Canadian Government roads range from $1.09 to $4.10 for each dollar of revenues, so that these roads are costing the taxpayers of the Dominion $200,000 a day.

South Africa is in the same boat with Canada and ourselves. The annual report of the general manager of the South African Railways and Harbors for the year ending March 21, 1920, shows that the 9,541 miles of Government railways earned a deficit for the year of $2,721,318.

Even Japan, supposed to be a model of Oriental efficiency, was obliged to admit an increase of expenses amounting to $29,776,332 in earning an increase in gross revenues of $29,921,043 in 1919, the last year for which statistics are available. Without continuing comparisons further it may be conceded that the disastrous after effects of the World War are felt by railroads everywhere; and that the plight of American roads is by no means peculiar.

No profound research is required to find a reason for the abysmal depression in traffic. The railroads are not hauling freight because there isn't much freight to haul. Of the small remainder of traffic some of the transcontinental portion goes by water, including the Panama Canal, which was built and is maintained by the taxpayers and so is not charged with interest, depreciation nor any of the embarrassing items from which the railroad accountant cannot escape. Of the short-haul traffic an appreciable quantity goes in motor trucks over highways also built and maintained by the taxpayers instead of at the expense of those who profit by the use of the trucks. No matter under what euphemism the fact may be disguised the canal and the highways traffic is subsidized. Without attempting to consider the merits or demerits of subsidies in any form and certainly without pretending to argue against the utilization of whatever facilities for the movement of traffic may be available, present purposes will be served by calling attention to this factor, which, though a minor one, is still of sufficient importance to affect adversely the diminishing returns of the railroads.

Of course the major factor is the very great depression in all lines of activity. Since the steel industry is generally regarded as the most reliable barometer of business conditions the fact may be noted that for the month ending May 7 the United States Steel Corporation operated at a rate slightly under 40 per cent of capacity, which was a decline from 90 per cent of capacity in January. The rate of production of pig iron for the same period was a trifle more than 30 per cent of capacity. Independent operators were averaging 30 per cent of capacity. Although freight rates are relatively low on steel and iron products they form an important bulk of railroad traffic. The heavy decline in steel production, therefore, is of significance to the railroads.

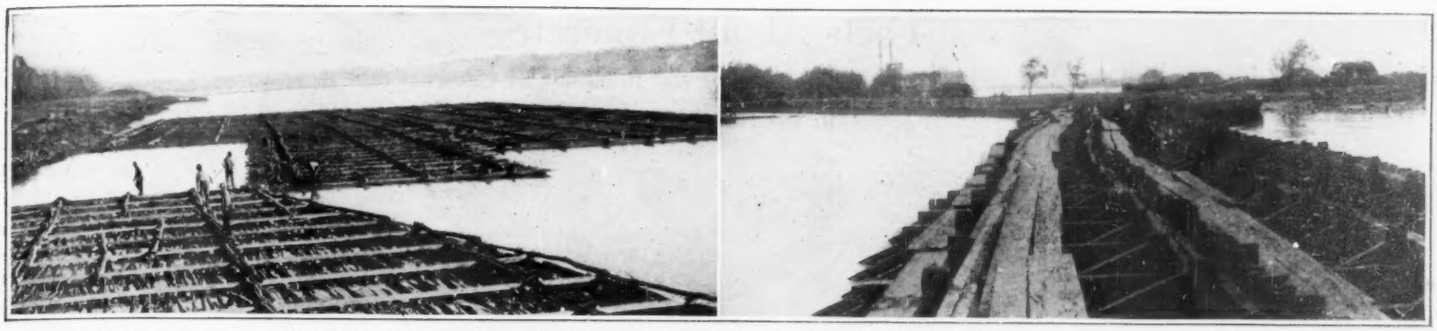
Coal and coke also pay low rates but bulk large in freight traffic. Here the depression is even more marked than in steel and iron. The United States Geological Survey reports that production of coal has steadily declined from a maximum of 12,800,000 tons weekly in December to 6,000,000 tons April 1, the lowest, with the exception of the strike of 1919, since 1914. Indeed, considering the growth of the country, the decrease in production is even more acute than in 1914. It is necessary to go back to the panic year of 1893 to find a parallel. Transportation capacity which could add 6,000,000 tons weekly to current coal production, is lying idle while an army of men is unemployed or, at best, is working but a few hours a week. Domestic consumption and export requirements combined for the first quarter of 1921 were 20 per cent less than for the corresponding quarter of 1920.

Yet another important item of freight traffic is made up of building materials and equipment. The more optimistic of builders had hoped for 35 per cent of a normal year; but even this modest anticipation seems destined not to be realized. Export trade, too, has shrunk materially.

Having established as a reason why the railroads are not moving a large

(*Continued on page 496*)

DIAGNOSES and prescriptions offered in the case of our railroads are as numerous as the diagnosticians and prescribers. The only difficulty is that no two of the self-appointed authorities seem to agree in their conclusions; and when doctors disagree we all know what is supposed to happen to the patient. Before giving up our transportation system to complete chaos, however, it seems that it might be worth while to make an effort to find out, without prejudice or prejudgment, what is really the matter with the railroads. We believe Mr. Carter is about as well qualified to speak on this subject as anybody. When he tells us that the roads are losing money because they are not doing enough business to make a profit at current rates and current rates of expense, he tells us what most of us know. But he makes it clearer, we believe, than it has yet been made—that the trouble is not with the rates—that these are entirely reasonable and proper. Indeed, this aspect of the question is so much his central theme that his contribution might well be entitled "What Is Not the Matter with the Railroads." We believe that Mr. Carter's article and the graphic comparisons of our title page based on it will give our readers some new ideas on the railroad problem.—THE EDITOR.



Left: Five miles of willow revetment like that here shown extends along the New Orleans water front. The picture shows the mat, which is made 100 feet wide by 150 long.
Right: The cribwork, filled with sandbags, that closed the crevasse at Buras

Some of the works by which the Mississippi is placed under effective control at and near New Orleans

The Storm King Road

By J. F. Springer

As one sails north on the Hudson River, setting out from New York, he will at first have on his left the noted Palisades. But after a time, there will be mountain-like hills on the left and similar ones on the right. When he has got to a point just a little north of West Point, he will come to a remarkable mountain-hill on his left. The profile will rise like the brow of some enormous skull and then bend more decidedly away from the river. The steepness of the slopes at the lower levels and quite a way up will perhaps astonish him, so nearly vertical are they. This skull-like dome is the redoubtable Storm King, the most notable pile of rocks along the Hudson. Just across the river, on the east bank, is Breakneck Mountain, also a bold affair and not wrongly named.

Round Storm King a state highway is under construction. This road swings round the gigantic knob in a splendid curve, rising to the north. Automobilists and others will get wonderful views from it, whether they look up the Hudson or down. The gorge or valley in which the historic stream lies widens northward of Storm King and Breakneck. It is as if, late in geologic times, the great ice sheet forcing its way south had been halted by these great masses of rock and had barely succeeded in forcing a narrow passage between them—the future passage of the Hudson River.

The location is, besides, one of engineering interest. For here is the exact place where the great inverted siphon of the Catskill Aqueduct makes the crossing beneath the river. At the foot of Storm King and close to the river, a shaft goes down to meet the aqueduct tunnel at a considerable distance below the surface. The shaft then becomes the aqueduct tube and continues on down to a level that is perhaps 1,100 feet below the surface of the river. The crossing is then made at substantially one level. The conduit then rises to a point at or near the surface at the foot of Breakneck and passes off as a tunnel toward New York City. The crossing is thus of the form of a U with a squared bottom. The hydraulic gradient of the aqueduct is, at the region of the crossing, about 400 feet above the river's surface; so that the bursting pressures inside the aqueduct at the lower level of the crossing is, neglecting friction, etc., something like 650 pounds per square inch. The road round Storm King will afford opportunities to view from one spot both sides of the river at the siphon crossing. The observer will not see much on either side to call attention to the aqueduct; but, if he has the foregoing in mind, he can hardly help being interested in the broad fact that the arms of the U terminate in Storm King and Breakneck Mountain.

Storm King rises to a height of some 1,400 feet above the river. Just south of it is a similar mountain-hill, Crow's Nest Mountain. There is a big notch extending back from the Hudson and lying between the two on the side next the stream. But this notch does not sever the one from the other. Naturally, the road follows the flank of Crow's Nest and then the south flank of Storm King. It rounds the steep face of the great pile and then goes on its way to Cornwall. From West Point to Cornwall will, by the new road, be a distance of 4 miles. Those who follow it will save a detour amounting to three times the length. It is impossible as yet to determine the cost. The estimated cost, based upon plans and specifications and the expected quantities of excavation, is $717,583. But so many variations from the expected have taken place and so many minor changes seem advisable that the total cost may run up to a sum between $800,000 and $900,000. A big part of the expenditures will go for a 2,000-foot section on the front of Storm King. On January 1, 1920, about 40 per cent of the total work of the road had been completed. Some of the more difficult parts of the job were pretty well along. In the near future it will be quite possible to motor from West Point to Cornwall by the new route and enjoy the magnificent views and note difficulties of construction that have been overcome. Despite the winding in and out along the flanks of the two big masses of rock, it has been found possible to construct the road entirely in the open. There are no tunnels. Nor are there any bridges. There are open cuts and fills and ordinary construction. There are plenty of sharp turns and some fair grades. But 90 feet is the minimum radius of curvature and 7 per cent the maximum slope. The narrowest subgrade in cuts is 24 feet wide and on the tops of embankments 26 feet. As a matter of construction economy, it was sought so to locate the road as to get just enough material from the excavations to fill in the embankments. But this ideal has not been altogether realized. Naturally, the fills over-balancing the cuts, this excess material has to be brought from its sources to the points of use. The hauls necessary run up to 1,200 feet.

The original plans have been viewed as subject to

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Controlling the Lower Mississippi

By Rozel Gotthold

Crest stages in the Mississippi and Atchafalaya flood occurred in 1920 during the latter part of the month of April. The river gage at Natchez, Miss., stood at about 51 feet; at Baton Rouge, La., it marked about 39; and at New Orleans, 19.6. The highest flood stages ever recorded by the United States Weather Bureau occurred at Natchez when the river stood at 53.6 in February, 1916; at Baton Rouge when it recorded 43.8 in May, 1912; and at New Orleans when it was 22, at the same time. Two crevasses occurred during April, 1920, neither bringing much damage because of the instant coöperation of the Federal engineers, the Louisiana State Board of Engineers and the members of the Levee Districts in the little towns themselves. The first was at Buras, La., which is 75 miles below New Orleans, and a short distance above the United States Reservation at Ft. Jackson. The levee caved in on a farm there during the night of April 16-17. The next morning, which was Sunday, the inhabitants of this town filled 3,000 sandbags, ready for the State Board and Government Engineers, who arrived to plan the closing of the break. Next came barges from New Orleans, loaded with lumber and thousands of sacks for filling. A break of 450 feet was closed within a week. It was filled with cribwork of the lumber into which sandbags were piled, the cribwork being sealed 4 feet each way. The material was taken from place to place along the levee by mule-drawn flat cars, the tracks for which were laid in small sections along the levee as the work progressed.

Buras is in the midst of a rich rice and truck-growing section. It has also large orange groves and extensive oyster beds. Everything would have been ruined had not the break been closed with dispatch. Especially would the flow of fresh water to the Gulf have completely ruined the valuable oyster beds. The cause of the crevasse was attributed, in the report of the Louisiana State Board of Engineers, not to high water, nor to the levee, which was protected from wave-wash by a wooden revetment in good shape, but to "subaqueous cause over which there was no control."

A levee is a simple piece of construction. A typical one looks like nothing but a mudbank, yet it may hold within itself the very life and soul of great cities. Upon the levee at New Orleans, for example, commerce

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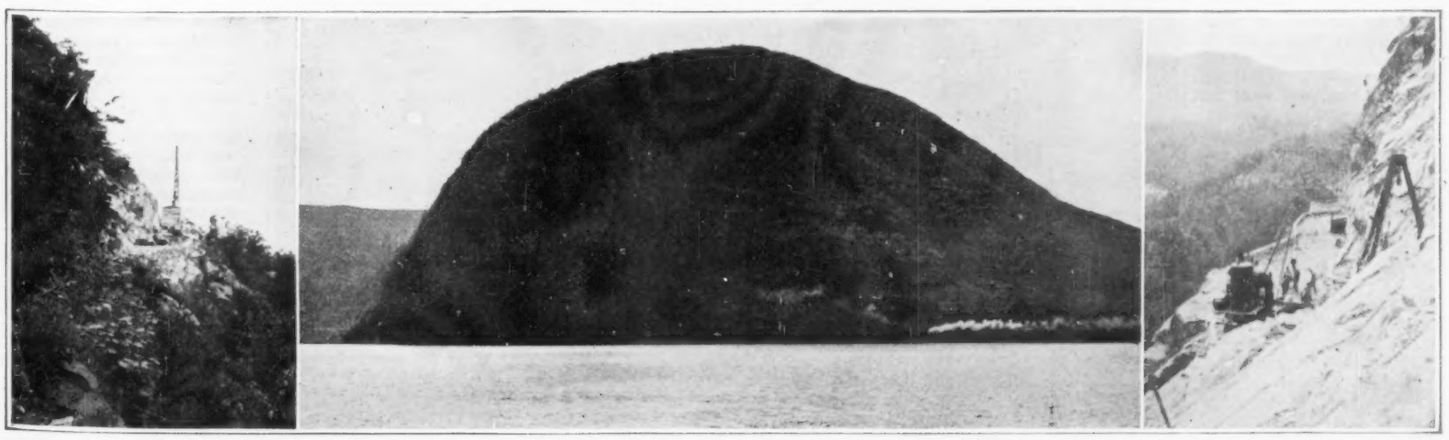


Two aspects of the construction of a road around Storm King, and a general view of the mountain from the river. It is across this face of the big pile that the road runs, being open to the river view at all points

Facts About Concrete

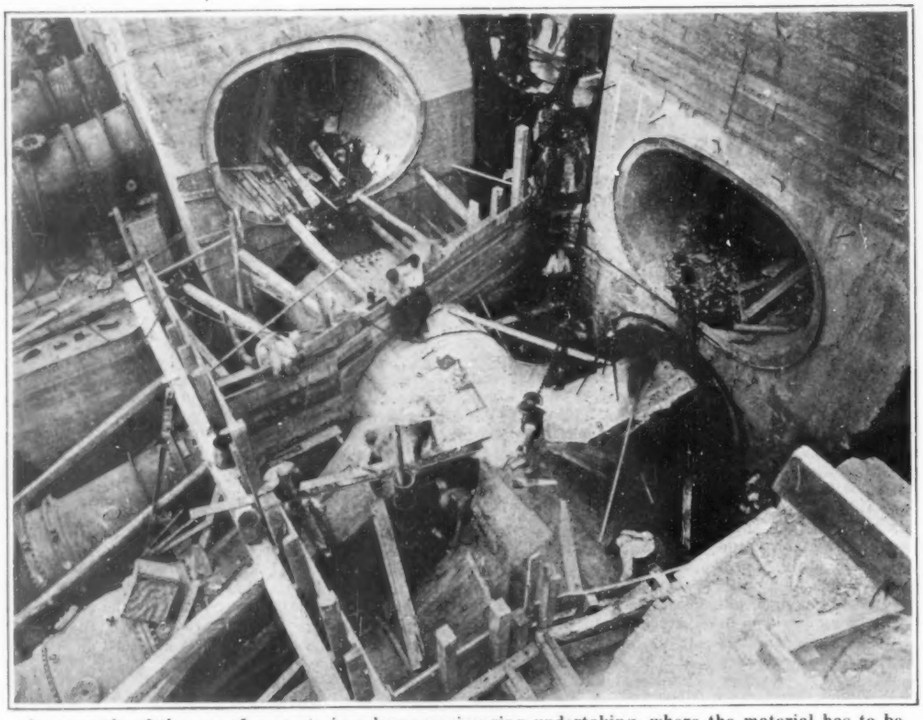
How We Are Expanding Our Knowledge of the Behavior of Cements and Aggregates

By Robert G. Skerrett

TO many persons cement and concrete are synonymous terms. There are thousands of our citizens, but little better informed, who think of concrete as nothing more complex than a casual mixture of cement, sand, broken stone or gravel, and water *ad libitum*. And in practice, the latter conception is fairly widespread, if one can judge by the common use of concrete and the seemingly indifferent manner in which its several components are thrown together.

Precious few of the public are aware of the exhaustive research that has been devoted in latter years to the intimate study of both cement and concrete; and these investigations have brought to light that concrete, especially, must be carefully compounded, appreciatively handled, and afterward given considerate treatment for a period of possibly weeks to make sure of obtaining the best results.

Concrete in construction work has established its worth in numerous directions; but the material has also failed at times and caused much adverse criticism. Broadly stated, most of these unsatisfactory showings have been due to preventable causes that may be fairly classed as ignorant procedure. From now on these disappointments should be fewer with each year's applications, while, coincidently, we should find more and more ways in which to employ concrete structurally to our economic advantage. Government and private laboratories have been engrossed with this subject for some time now, and facts of the utmost importance are being continually disclosed.



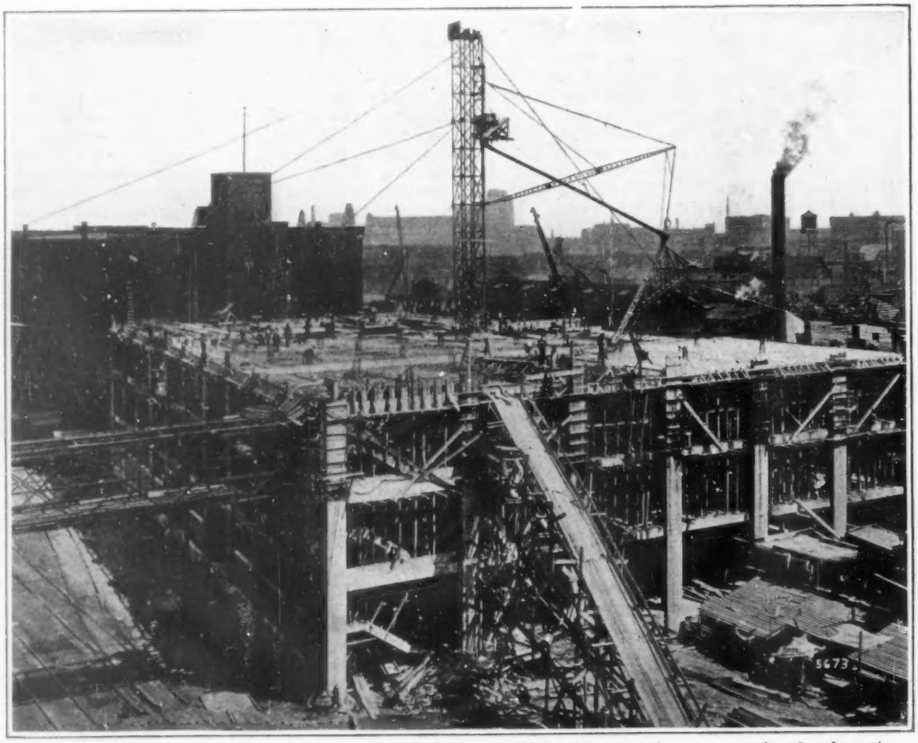
An example of the use of concrete in a large engineering undertaking, where the material has to be counted on for permanence

For the sake of the uninformed, let it be said that cement is the product of some kinds of stone and clay, which have been ground fine and burned in a kiln to the point of incipient fusion, after which the clinker so obtained is thoroughly pulverized. Simple as this sounds, Portland cement would not be what it is if its manufacture were not followed continually by the watchful and highly trained chemist. Upon him rests the burden of selecting and proportioning the several constituents and then seeing to it that these are duly calcined and reduced to the powdery form familiar to most of us.

As may be imagined, the application of heat drives out the contained moisture in the raw materials; and one has only to add water to the cement to provoke a reaction which will cause the stuff to "set" and to become once more a petrified body. Similarly, when cement is mixed properly with the right measures of sand, gravel or stone, and water, the combination is intimately bound together in a few days and grows as hard as a rock. Further, the concrete may even prove superior in divers respects to some stone formations of nature's own making. But before we take up concrete let us consider some of the things about cement which the laboratory has revealed to us of late.

The chemist and the research engineer have joined hands to deal with cement scientifically, and they have devised apparatus and methods for its testing so that they can specify with certainty what the material should be able to do if correctly made and treated in service. Every up-to-date producer of Portland cement in this country is profiting by these facilities and the standards so prescribed. Nothing is now left to guesswork. Ingenious instruments are employed to ascertain the specific gravity, the fineness, the normal consistency, the soundness, the time of setting, and the tensile strength of the dry cement, cement pastes, and mortars, respectively. And then, the studies embrace what happens to sample briquets and test pieces in storage under circumstances approximating those of practical application.

For years, the manufacturers of cement did not realize that their commodity might be modified to advantage by pulverizing the slag to a greater degree of fineness. Today, after protracted inquiry, it is known that the fineness of cement has a decided bearing upon the strength of the concrete made with it. The Government experts have reported that concrete made of the so-called fine cement was regularly and consistently stronger than concrete made of the somewhat coarser cement. In meeting the requirements of a given job, the finer cement permits a saving of from 1.2 to 2.1 bags of cement for each cubic yard of concrete. Again, another investigator finds that the finer grinding of the cement quickens the setting of the mixture and hastens the hardening of the concrete, results that might be very desirable at times.



Concrete floors of the sort here shown can be put up with confidence only as a result of exhaustive investigations of Government experts

From the popular point of view, it might be thought, and not unreasonably, that the dominating factor in a satisfactory concrete batch would be the amount of cement used. Curiously, on the other hand, we are informed that the measure of water more often than otherwise is the thing that either makes or mars the physical value of the aggregation. The methods of proportioning concrete which have been proposed in the past have failed to give proper attention to the water content of the mix. Experimental work has emphasized the importance of water in concrete mixtures, and shown that the water is, in fact, the most important ingredient, since very small variations in water content produce more important variations in the strength and other properties of concrete than similar changes in the

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Left: Aviator standing out on the plane and holding on to one of the struts, just before the parachute jump. Note how the parachute is pulling on the shoulder straps. *Center:* The Irving parachute closed, showing how the pulling of the ring pulls out the pins that hold the bag closed. *Right:* The Irving parachute opened up, just after landing

Details of the Irving parachute and how it is used in descending from airplanes while in flight

Making the Airplane Fireproof

OF the several dangers that confront the active airman, the one which he dreads the most is fire in midair. The airplane, as generally built, is a highly inflammable structure, especially with its many gallons of highly inflammable gasoline. From time to time there have been reports of special fireproofing compounds being developed for protecting the usual airplane construction, but it has remained for Parker R. Bradley of New York City to perfect this form of protection and to demonstrate its practicability before flying club officials and others.

Mr. Bradley has spent nearly thirty years inventing and developing waterproof fabrics and making waterproof mixtures and dopes, the raw material in almost every case being nitro cellulose. Several large industries have been established under his supervision to manufacture the products which he has invented. In fact, Mr. Bradley is the inventor of artificial leather, pantasote, keratol and artificial rubber. All of which is by way of introducing his present work.

The fireproof airplane which was used in demonstrating Mr. Bradley's system of fireproofing was made super-fireproof, so to speak, in order to withstand almost any degree of heat and flame that might be applied to it in numerous tests. Not only were the wings and other doped subjects sprayed with gasoline and ignited, but large quantities of all kinds of fireworks were attached to wing surfaces and other vulnerable parts and repeatedly ignited while in flight without damage to the airplane and with perfect safety for the pilots.

However, for ordinary commercial and military purposes such super-fireproofing would be unnecessary. Fires in the air or on the ground do not, as a general rule, commence with a conflagration, such as made in the tests, but from small quantities of ignited oil and gasoline. These being on fireproofed surfaces could not spread and would quickly burn out.

Completed airplanes can be fireproofed only by removing all doped fabrics and recovering them by the new Bradley process. The existing tank must be replaced by a specially designed leakproof, fireproof, heatproof tank. Such a tank, we are told, will not explode, ignite or burst on crashing. No fireproofing could withstand the bursting of the gasoline tank in a crash for the reason that in the wreck the woodwork would be shattered and exposed to the action of fire, the fireproof protection having been broken through.

Aside from fireproofing the airplane, Mr. Bradley has devised a fireproof suit for aviators, which is shown in one of our illustrations. This suit consists of a helmet, coat and trousers. The helmet is made of sheet aluminum covered with a 3/8-inch layer of hair felt painted with three coats of the Bradley fireproof paint. Attached to the bottom of the helmet is a skirt of cloth, fireproofed by the Bradley process, which is tucked inside the suit proper. Air is forced into the helmet by means of a pipe which has its open end in the propeller blast, and exhausted from the helmet through a second pipe. The exhaust pipe has a gauze-covered end which pre-

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An aviator's fireproof suit, consisting of an asbestos suit and aluminum helmet

Testing an airplane of the usual construction which has been treated with the new fireproof paint. The wings have been saturated with gasoline and then ignited

An Airplane Parachute That Is Safe

THE Irving parachute, recently adopted by the United States Army, has been the object of experimentation by Mark M. Campbell of Venice, Cal., during the past few months. Campbell's work has been unique in the field of aircraft, for while others have been studying airplane and dirigible improvement, this man has been pioneering in the field of parachute work as applied to aircraft as a safety measure. He is said to be the only civilian permitted to work with the Irving parachute.

The new parachute, devised to work without fail when called upon, has never yet refused to open in all of the Campbell experiments. These number into the thousands and include tests at all elevations, under every imaginable wind condition, and with the parachute handicapped in every way the ingenious young aviator could devise.

The principal feature of the new device is a supplementary umbrella which is attached above the top of the parachute. This tiny umbrella has, as its function, the opening of the parachute. The flier carries the parachute packed in a canvas case on his back. A ring hangs over his shoulder and to the cord which is attached to this ring are fastened the pins which hold the canvas case shut.

In an emergency, the aviator simply pulls the ring. This pulls out the pins and lets the case open. The little umbrella is on top. Its spring ribs instantly force it open and as it flies back in the wind, it pulls the top of the parachute along, thus preventing any chance of the parachute getting tangled up or not opening. Before the aviator lets go, his chute is open and all he has to do is step off and descend in the parachute. The chute is strapped to him and his hands are free.

For exhibitions, the jumper goes out on to the wing of the plane, opens the chute, and lets it pull him off. In an emergency, the pilot of a stalled or burning plane stands up in the pit and pulls the ring. The chute, opening in the wind, lifts him right out of the compartment into the air.

Either as a safety device or as an exhibition affair, the new parachute seems to be as near "sure fire" and safe as is humanly possible. With that much established young Campbell is continuing his pioneering efforts with a view to establishing a system for the control of direction and landing in a parachute. The results will be interesting to watch.

Another Giant Italian Plane

FROM Turin it is reported that another Italian constructor, this time Signor Ricci, is completing a huge machine. The Ricci machine, unlike the ill-fated Caproni, is stated to be a quadruplane, with a total horsepower of 5,000 and a wing area of 8,600 square feet. The machine is designed to carry 130 passengers, and the estimated speed is about 90 miles per hour. The useful load is given as 20 tons.

Brief Fallacies About Money

An Attempt to Refute Some of the Ideas on Which Satisfaction with the Present System Rests

By Charles E. Duryea

WITHOUT proper diagnosis correct treatment is unlikely if not impossible. This medical maxim applies with equal force to our politic and economic bodies. The great facilitator of business is Money. But when we need money most we find it hardest to get. We know that our financial system lacks the flexibility it ought to possess to serve our needs but we content ourselves that it is better than formerly and do not seek to carry it to perfection. We too readily assume that "it has always been thus and always will be." Believing that this and other fallacies are truths and that improvement cannot be had, our business men suffer in silence and wait for time to reduce our condition to a level where our faulty money does suffice. They recognize we are losing millions of dollars in time, profits and turmoil but due to faulty teachers and leaders they think nothing can be done. They should wake up.

A half truth is the most dangerous doctrine because its fallacy works under the shelter of its truth and does great damage unobserved. Our money system is thus cursed. Although simple in basic principles, it is so often rendered confusing by those who attempt to expound it, that students give up in despair. Few business men understand the facts and fallacies about money and we all suffer needlessly. Let us examine them. There are four fallacies of lending and most damaging type, viz., the "has always been," the psychologic, the quantity theory, and the interest rate.

With few exceptions which must be neglected in a brief summary, money has always been scarce, too scarce to permit doing the business that could have been developed; it has ever sought hiding in time of crisis and been very slow about reappearing; it has fluctuated in value—purchasing power—both as its materials—gold and silver—fluctuated and inversely as other commodities were scarce or plentiful, and has been ever dependent on the accident of mining or conquest as to its amount. "Can these things be changed? Not likely." Such is the belief of the average man and such was his belief as to autos and flying machines some years ago. But mechanics knew better and will readily understand that the ancient invention—money—has been improved. Paper money is that improvement, and it now rules the money market.

So much better is it than metal money that even though our own nation has an unprecedented quantity of gold we do not use gold money. So much better is paper that even a thousand years ago, Bank of Venice money, unredeemable paper, commanded a premium of 30 per cent often for long periods and in spite of usury laws. We finished the Civil War on paper money. Our Supreme Court in 1880 established its standing as proper and lawful money. Since then we have been using it more and gold less. The World War completed the process and placed the more developed nations on a paper basis for all time to come. Now we are in a position to adopt money legislation that will meet our needs fully. The Federal Reserve and Farm Loan Acts were big steps to that end. We must extend them.

"But," says the well-informed skeptic, "money alone will not fix our troubles. In boom times we overproduce and then must shut down until consumption catches up. So we will ever have booms and panics. We cannot change the psychology of humans." Partly true but mostly wrong. We can do even that. The fire drill has saved many a group of school children that without would have been piled in a heap on the stairs by maniacal mob psychology. Stabilized money will stabilize prices and measure needs by actualities instead of by fickle, fluctuating daily quotations. Low interest will permit carrying stocks until conditions require them and both will make business a certainty with low profits and few risks instead of a gamble by men who must profiteer to fortify against loss. A right money system will furnish conditions so dependable that psychology will cease to enter in the determination of values.

Again the student of an age that has gone arises and says: "But low interest money, right off the printing press, would soon be of such quantity as to have no value. Look at Russia! Look at all the European countries!" "Every child knows that the more there is of a thing the less its value." Sounds like truth indeed. But is it? No! The Quantity Theory does not apply to properly issued paper money and postage stamps. It does apply to commodities and to money which gets its value by being made of a commodity, like gold money. Increase the amount of gold and the value of gold falls both in the arts and as money. Issue paper money which displaces gold and the effect is the same as finding more gold. We long ago passed that point. When we issue paper money now we need gold for reserve or "cover." This tends to raise its value rather than the reverse.

Since the Quantity Theory applies to commodities, their price and consequently the apparent purchasing power of money is affected inversely by their quantity. This must not be forgotten. During the war we paid much money to workers for war goods and made fewer peace goods. They used that money to buy the few peace goods and bid prices up. A scarcity of peace goods, profiteering and such things, and not the quantity of money sent prices up. Our paper money did not depreciate. It still buys the usual and legal amount of gold. Few recognize this. We received much gold from abroad and this cheapened gold. This also sent up prices as we have found out in everyday life.

Having learned that shortage of peace goods was the cause of high prices we see that we should have produced more goods—not restricted our money. But this is off the subject. "What is 'properly issued paper money' and how much may and should be issued?" Sufficient to meet the needs of business without commanding premiums, commissions, or high interest rates and *never* more than can be redeemed on presentation in some commodity of the stated face value. Certain redemption is the wall of protection against depreciation. No man, knowing that he can get the agreed value of his dollar by presenting it at a window, will take less. Now will he? Certainly not. Nor does he care how many others exist. The only essential for sound paper money therefore is *certain redemption*. Postage stamps never go below par although the vaults may be full of them and they have no "cover" except the mail-carrying facilities. But let Uncle Sam stop redeeming them by carrying our mail and they at once become valueless. How can any one deny these simple things?

"But how can Government redeem a great volume of money in gold?" Perhaps it cannot. Nor does it need to. We formerly redeemed in both gold and silver. But at a fixed ratio. That was wrong. We must give Government the option to redeem in gold or in any stable commodity in such ratio as exists in the open market that day of redemption. Most of us after the war found Uncle Sam would give us better value for our dollars in canned beef and similar things than we could get at the usual stores. That was redemption of paper money. State the value of the paper in terms of gold and redeem in many things of the same value. This settles for all time the doubts about redemption. It permits nations which do not produce gold to keep their money on a gold basis. Sooner or later it must be done. We need it now.

Our most damaging fallacy relates to interest. Learned professors, suffering from their own theories, tell us people will not save unless they can lend at high interest. (But thousands do save and hide their money.) That interest represents self-denial of present spending in the hope of larger future spending. (But many wealthy deny themselves nothing and still have money to lend.) That the rate is a matter of supply and demand, but the Controller of the Currency says (Vol. 1, 1920 report, pp. 79 and 87, "renewal rates are artificially fixed daily by small coteries in secret meeting" and that these rates are "highest in the world," "unjustifiable," "cause of exorbitant rates for new capital," "and for huge shrinkage for all security values." Clearly professors err. Space limits further showing.

Here are two examples every mechanic can understand. A city needing a market house and wishing to save interest, agreed to pay for the labor and material by issuing its promises to pay without interest, and by agreement of its people to accept those promises as money until the taxes and rental receipts could redeem them. It worked. The people gained and only the money lenders lost. Another. A maker of seasonable goods requiring skilled men had not capital to continue producing during the dull season. The goods were safe security for a reasonable loan but the time had to be longer than 90 days and the thought that foreclosure would likely follow failure to pay "on the day" precluded a bank loan. So men skilled by a season of training, had to be laid off. Their families suffered while they, with less courage than before, sought another job. Those remaining were also affected and their output decreased perhaps 50 per cent. Overhead had to be redistributed with resultant increased prices and lessened business. When the days came that the goods could be sold, then began a rush to get and train more men and try to win back the position of a half year before. The struggle should have been to move forward from that advanced position. The final result was failure. The cause reported was "too little capital." Workers, both bosses and men know this is no fancy picture but is a continuous tragedy. Yet how easily remedied. If this maker could have applied to a government institution and received on presentation of ample security, such a loan as he needed for such time as he desired, at 1 or 2 per cent interest, he could have kept his shop running, his men enthusiastic, busy and happy and all adding to the prosperity of the community. When he sold his goods he would have returned the borrowed money and it could have been canceled.

Nor is there any danger of inflation by such a process. Every dollar loaned a producer puts far more than its value in goods on the market. Every such loan would be secured and redeemed by the borrower so Government credit would be benefited rather than injured. We have learned that streets and roads should be free; and that the mails should be carried at cost. It is time for us to learn that money is even more a public utility than those things and should be so handled that one having fixed wealth can convert a safe portion of it into liquid wealth for the benefit of all. Our only hope to avoid being swamped by the low wage and low exchange products of Europe is to give our producers easy money at long time and low interest. We should do this before competitors take the markets of the world away from us.

IN our issue of March 12th we gave Mr. Duryea space in which to present his views as to what is the matter with our money system. At the moment we were not, ourselves, absolutely convinced that anything was the matter with it; but Mr. Duryea's argument impressed us as decidedly interesting, and as possessing enough inherent plausibility to justify our giving it a place. It will be remembered that we did this, however, with the editorial fingers crossed, to the extent that we washed our hands of all controversy by putting this off upon Mr. Duryea. Mr. Duryea has had controversy as a result of his article, and plenty of it. We have seen some of the letters he received, and have read them with interest. As a result of the reception of his first article, Mr. Duryea has prepared a second, and has asked us to find space for it. Almost at the same moment, we picked up our morning paper and read the exposures in connection with the New York investigation into the building situation. It appears fairly evident that when the people who have money to loan can lend a builder $9,000, and collect interest on $15,000, and collect $15,000 on maturity of the loan, and when the builder has to accept these terms or none, the statement that there is a money trust and that its operations are harmful is altogether within the facts. We can think of no more timely circumstances for the appearance of Mr. Duryea's second article than on the wake of this exposure, so we hasten to put it in our first available issue.—THE EDITOR.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Unit of Values

To the Editor of the SCIENTIFIC AMERICAN:

We have various units of measurements, weights and capacities. We are not satisfied with anything short of perfection in these units. The unit of length was for years a platinum bar and the scientific and business world was so careful of this unit that it was kept in an underground vault in Paris and was inspected only once in ten years. We think this great care justified. Our standard unit of values should also be put on a scientific basis. The platinum bar never varied a fraction in length. Should not our unit of value be just as reliable? FRED NIHART.

Homedale, Idaho.

Millions and Billions

To the Editor of the SCIENTIFIC AMERICAN:

An appeal for the amended use of the word "billion." In American journals it is commonly used to signify a thousand millions. But that is not its etymological meaning. A million is the unit. The second power is a billion, the third a trillion, the fourth a quadrillion, etc. A billion is therefore a million millions.

It is not necessary to question the right of any persons to make the word mean what they please, but to call a thousand millions a "billion" is to misappropriate a word which has already a conflicting signification. It is therefore certain to lead, as it is already leading, to practical inconvenience. In a recent number of the SCIENTIFIC AMERICAN, the first article was a brilliant discussion of astronomical distances using the word for a million millions. In the same number was an important article on the lumber trade in which the word meant a thousand millions. Experienced readers soon grasp the intended sense, but others must be quite at sea.

If billion is used for a thousand million, what word will you use for a million millions?

Of course if "billion" is limited to its correct meaning the language will be in need of a word to express a thousand millions. That number is not in the "million" but in the "mil" series. It is the third power of a thousand, and the word "trille" or "tril" would be correct. It is respectfully submitted for consideration. J. M. BUCKLAND.

Johannesburg, S. A.

[*It seems to us entirely a question of usage whether, as Mr. Buckland says, the million or the thousand be the "unit." In the former case his claim is correct; in the latter the recognized American usage is justified. We should think it more logical to take as "unit" the first number which requires pointing off of a "period" of three ciphers.*—THE EDITOR.]

A War Memorial Suggestion

To the Editor of the SCIENTIFIC AMERICAN:

While reading your interesting illustrated article on the proposed bridge over the Hudson River it occurred to me to suggest:

1. That it be called The Memorial Bridge;

2. That the partition between the foot passenger way and the trolley track be made of bronze in tablet form adequate to receive the names of all of our immortal dead who gave their lives for the welfare of humanity in the World War.

Each state and territory could be allotted to it the tablet space required to enroll its heroes. The ensemble to be under the direction of the bridge architect. Each state and territory could, under specifications, furnish its tablet or tablets with the names of its soldier and sailor dead engraved thereon, of course in strict harmony with the general design of the memorial architects.

The advantages of this memorial scheme are many.

(a) The space is so ample that the dead could have expressed their divisional, regimental and company connections.

(b) This memorial would represent the nation's unity of effort made by our soldiers and sailors in humanity's behalf.

(c) Their one great purpose would be set forth by the one great memorial.

(d) It would honor each *individually* and yet,

(e) It would associate them forever as comrades in death. JAMES SHARON MACCOY.

Yonkers, N. Y.

Danger in Garage Pits

To the Editor of the SCIENTIFIC AMERICAN:

I have noticed in your issue, dated May 14, that on page 393 there is a highly dangerous suggestion in regard to open pits for automobile repairing in garages. Owing to the fact that gasoline vapor is heavier than air, it always seeks a lower level and collects in any pits and holes available, where it awaits the first accidental spark, carelessly thrown match, or other flame. Experience has shown that the necessary accident to cause an explosion always arrives sooner or later, and the use of garage pits has consequently been prohibited in a number of cities, including New York City and Newark. Before this prohibition went into effect, one pit explosion was caused by the slight spark struck between a wrench and a rusty nut on which it was being used. These explosions, aside from their general hazard, almost inevitably result in the death of the mechanic who is in the pit at the time. I trust you will place this danger before your readers with the same prominence given the original article.

New York. W. E. MALLALIEU.

Rifle Velocity

To the Editor of the SCIENTIFIC AMERICAN:

On page 409 of the issue of May 21, 1921, in discussing the star Betelguese, the statement is made that the maximum velocity of the modern rifle is 2,800 foot-second. The writer of that article may know something about popular astronomy, and, incidentally, about Betelguese, but he knows nothing about modern rifles. What about the Savage bolt rifle of 1920, 3,000-250? What about the present U. S. Service rifle? What about many others of American and foreign make all exceeding 2,800 feet per second?

Courtland, Cal. W. J. ALEXANDER.

[*The writer of the article in question gave 2,800 foot-seconds as a fair average velocity, not as a maximum velocity.*—EDITOR.]

Red Rust in Hot Water Pipes and the Cause

ALL housekeepers are familiar with the appearance of red rust in hot water pipes but the actual cause of this is not generally known. A Boston professor recently discussed this before the New England Water Works Association and stated that the common theory has been for many years that rust was formed by the direct union of the oxygen and the air, water and air, but this is now proved not to be the case. In order to form rust the iron must actually go into solution in the water, he says. If oxygen is present it unites with this dissolved iron and separates out as red rust. When the iron dissolves in water an equivalent amount of hydrogen is set free as gas and forms a protective coating on the iron, but if oxygen is present in the water it unites with the hydrogen and the protection is removed. Where there is a complete absence of oxygen in the water no appreciable corrosion will take place. The action of all the factors causing corrosion is accelerated by rise in temperature; hence a hot-water supply system in which hot water fully charged with atmospheric oxygen is constantly passing is a most vulnerable structure. Since oxygen is consumed in the formation of rust, it follows that if water is held in contact with iron it will lose its dissolved oxygen and become inactive. It is on this principle that "deactivisers" have been introduced. In a Boston apartment house with large central-heating equipment, the method adopted was to pass the water from the street main into a heater where its temperature was raised to 160°F. It was then passed through a storage tank containing iron sheets that had been chemically treated so as to cause rapid corrosion, and finally through a filter which prevented the red rust formed from passing into the heating system.

A New Dental Anesthetic

A COAL-TAR chemical for the elimination of all pain in dental surgical operations, simple of application and suitable for repeated and universal use in oral surgery, is announced by Dr. Joseph A. Klein of New York City.

This new chemical is liquid in form, is applied on a pellet of cotton to the gum or mucous membrane surrounding the tooth to be anesthetized or into a cavity prior to excavation where a tooth is to be filled or treated. It produces complete local anesthesia in from two to eight minutes, and eliminates all feeling for from one to six hours.

Dr. Klein has extracted teeth and pulps painlessly by the use of this chemical. Its effect is entirely local, so it may be applied with perfect safety, regardless of the patient's age or general physical condition, and it is particularly valuable as an anesthetic in the extraction of children's teeth. It leaves no disagreeable after-effect, but because of its long period of activity gives the nervous system ample time to recover from the shock of operation before the nerves in the area of operation regain their normal feeling or activity.

Paper Salvaging in the St. Louis Public Schools

THE excellent work done by the public schools of St. Louis in salvaging waste paper during the school year 1919-20 was described by former Secretary of Commerce Alexander in *Commerce Reports*. That this campaign was not only being sustained during the past year, but was accomplishing remarkable results, is evidenced in the following data furnished by the assistant superintendent of schools for St. Louis on November 22, 1920:

Pupils in the St. Louis public schools collected and brought to school 494,181 pounds of waste paper during the first quarter which ended recently. This amount represents an average contribution of 4.94 pounds for each of the 100,000 children now attending the public schools. If the rate established during the first quarter is maintained for the balance of the year, approximately 2,000,000 lbs. of paper will be salvaged.

During the week of October 17-22 more than 35 tons of old newspapers and magazines were collected by 100,000 pupils in 135 public schools, according to Stephen M. Wagner, chairman of the public school thrift committee. This amount is the largest collected during any one week since the waste-paper-saving movement started in the schools several years ago, and represents a value of $1,211.40 at present prices paid for waste paper. Receipts for the year are expected to exceed greatly those of last year, when a net profit of $17,308 was realized from the sale of 858 tons.

A 5-ton automobile truck has been purchased by the association to take care of the increased paper collections. This will replace a 2½-ton truck, which has been found inadequate for the business.

Saving paper has become a regular part of a well-planned system of education for thrift in the St. Louis public schools, and the children are taught that a great many things that heretofore were thrown away can be made use of and be of real value. The proceeds of this work are credited to the Teachers' Benevolent Annuity Association, an organization of teachers formed for the purpose of aiding those who retire after long service and of relieving members temporarily in need.

Fire Proofing Wood

THE Technical Notes of the Forest Products Laboratory report some progress in the preparation of fire retarding paints as the most practical means of making small amounts of wood somewhat fire resistant. Older methods of impregnating the wood with chemicals under pressure or means of keeping it moist are usually too expensive for small projects although they are more effective. It is interesting to find that the ordinary white wash or calcimine has proved to be as satisfactory as any other type of paint. A coat of calcimine will not prevent the burning of the wood if exposed continuously to great heat but it does materially decrease the danger of a blaze spreading from sparks, cigarettes, and other small sources of fire. Calcimine is naturally best suited to inside uses. For outside work the Laboratory has developed a coat which consists of zinc borate and chrome green ground in linseed oil. This paint after three years of exposure to the weather has retained its fire resisting properties.

Transmutation of Elements

DR. CHARLES BENSON DAVIS of New York City claims in a paper which he has prepared and submitted to Engineering Foundation, that he can make and has made some of the chemical elements, such as gold, silver, platinum and copper by transmutation of a common element. He has shown samples of the metals he claims to have made to members of the Engineering Foundation in New York City, and has requested that body to investigate his claims and his methods. Dr. Davis is a reputable chemist, a member of the Society of Chemical Industry, a Fellow of the British Chemical Society, and an honorary member of the Société Académique d'Histoire Internationale. He is the author of several papers which have been published in chemical journals.

The Craters of the Moon

Possible Light on Their Origin from Experiments with Airplane Bombs at Langley Field

By J. F. Springer

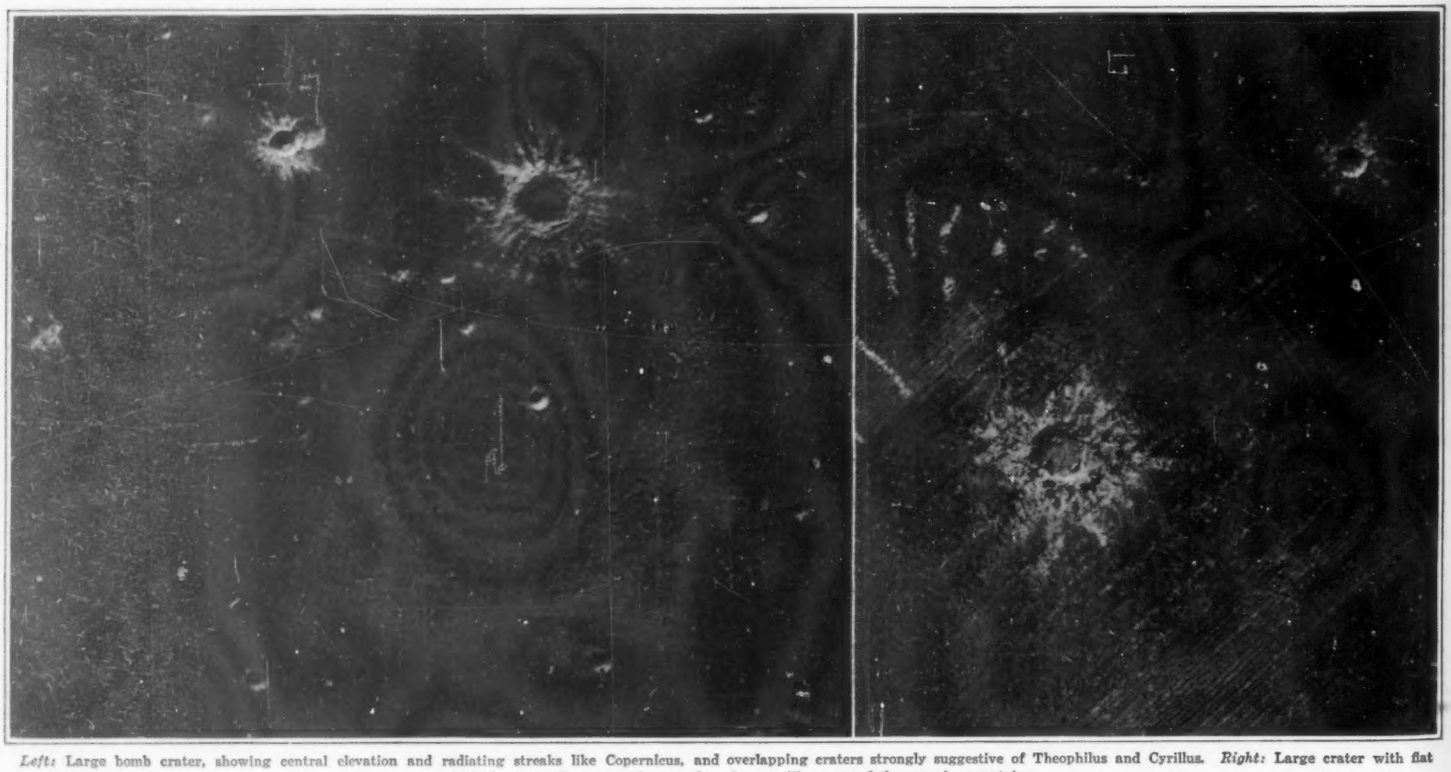
THE moon is our nearest celestial neighbor, being only sixty terrestrial radii distant. Markings on its surface are plainly visible to the naked eye. In the field of the large telescopes these markings assume, many of them, quite definite forms. Thus, a large proportion resemble more or less closely volcanic craters on the surface of the earth. It has been held pretty generally that depressions of this description on the lunar surface are really the result of volcanic action. But more recently a rival hypothesis has arisen. In accordance with it, the crater-like formations are the result of the impact and penetration of meteoric bodies. Which is the true hypothesis, if we exclude further alternatives? The present article gives certain recent evidence in favor of the meteoric hypothesis, this evidence having been brought forward by Maj. Herbert E. Ives, late of the Aviation Service. This evidence is the result of experiments carried out for military purposes on Langley Field. The effort of the military authorities was directed to the purpose of getting definite and reliable information of the effect of dropping bombs from airplanes. Photographs shown herewith disclose bomb-formed depressions markedly like those found on the moon. It is thought that the depressions made on Langley Field are of exceptional value because of their considerable size, outranking in this respect other experiments previously carried out with the view of noting the effects of impact. Thus, the depressions on Langley Field run up to craters of such size as to require for spanning the opening a line of 20 men with hands joined. Of course, the lunar craters run up to much greater sizes. Ten, twenty and even sixty miles represent diameters of actual depressions on the surface of the moon. The earlier experiments may be suitably classed as laboratory, in contrast to the results produced on Langley Field.

A bomb crater so large that it took twenty men to span it

That there has been and perhaps is still volcanic activity on the moon may be supported by certain facts. The name Plato has been given to a very large lunar crater 60 miles in diameter. The floor is a plain on which are scattered a considerable number of small conical piles. Some of these have a diameter of only a few hundred feet; others of as much as a mile. British astronomers mapped the crater floor shortly after the close of our Civil War, thus accurately locating 36 of the cones. About 1881, four British astronomers worked out another map showing 38; and in 1892, Prof. W. H. Pickering made a map on which 42 were located. A comparison of the three maps shows that only four cones are common to all. Changes in brilliancy and complete disappearances were disclosed by Professor Pickering's studies in 1892. Altogether, there is pretty good evidence that Plato was by no means inactive in the period 1870-1892.

A representative lunar crater will have its floor at a lower level than the land of the neighborhood. This contrasts with terrestrial craters in general. Often a lunar crater will disclose no central peak, and the amount of material in the surrounding ridge is less than with us. However, Professor Pickering finds that Hawaiian craters approximate more or less closely those of the moon. Kilauea and Mauna Loa, both on the Island of Hawaii, have crater floors of considerable size from which rise circular enveloping cliffs varying from 500 to 1,000 feet in height. There are no very tall volcanic cones on them. These and other points create a considerable list of resemblances to lunar craters. The crater floors are, however, higher than the neighboring sea level. But Professor Pickering calls attention to the fact that the exterior sides of these volcanoes slope so gently that if many such mountain forms were grouped together, the general surface would be decidedly higher than the crater floors. As to size, the two or three miles of diameter of the Hawaiian craters are very much smaller than numerous, very numerous, diametrical measurements across the lunar craters. However, if allowance be made for the difference in gravitation, it is permissible to expect the moon's craters to have about six times the diametrical size of those on the earth. The "two or three miles" then becomes in effect twelve or eighteen miles. Even so, we are short of such big craters as Plato. However, there are on the surface of the earth three craters having a diameter of about fifteen miles. One is located in northern Kamchatka, another is Mt. Asosan in the Japanese Island of Kiushiu, and the third is Lake Bombon and its surroundings on the Island of Luzon, Philippines. Altogether a formidable array of evidence may be piled up in favor of the volcanic origin of the craters on the moon.

As far back as 1873, the astronomer Proctor sug-



Left: Large bomb crater, showing central elevation and radiating streaks like Copernicus, and overlapping craters strongly suggestive of Theophilus and Cyrillus. *Right:* Large crater with flat central plane, smaller one with central peak, very like some of the moon's mountains

Impact craters from Texas that closely resemble the big pits observed on the surface of the moon

gested the meteoric theory. The objection has been raised to this conception that meteors of sufficient size that would approach the moon at rates of speed comparable with those of the planets would do too much. The planetary bodies move, it must be confessed, at some speed. Thus, the orbital rate of the earth is in the neighborhood of 18.5 miles a second. A big meteor coming in on the moon at a terrific speed would, by its impact and sudden stoppage, melt itself, any crater walls that might form, and even a ring of the surrounding country. If the meteor struck obliquely, the crater—allowing that a permanent one would be formed—would not be circular but of an elongated form. But the lunar craters show a general perversity in adopting for themselves the form of a circle. However, if we are to regard the moon as originally derived from the earth in the form of fragments, then these objections may be pretty well removed. In the first place, the fragments falling on to the general mass would not be moving relatively to that mass with anything like the rapidity of planetary bodies. The excessive amount of heat upon impact and stoppage is thus eliminated. Further, it seems that these fragments falling in on the central mass would direct their motions toward its center, and would consequently create circular depressions.

One investigator (Gilbert) dropped globules of water on to the surface of thin mud and produced craters with enveloping walls and sometimes with central peaks. Dr. Bigelow of Boston fired pistol bullets into plaster of paris while it was hardening and Mr. R. S. Tozer bombarded a clay surface with balls of the same material. Some of these clay craters turned out to be quite similar to those on the moon.

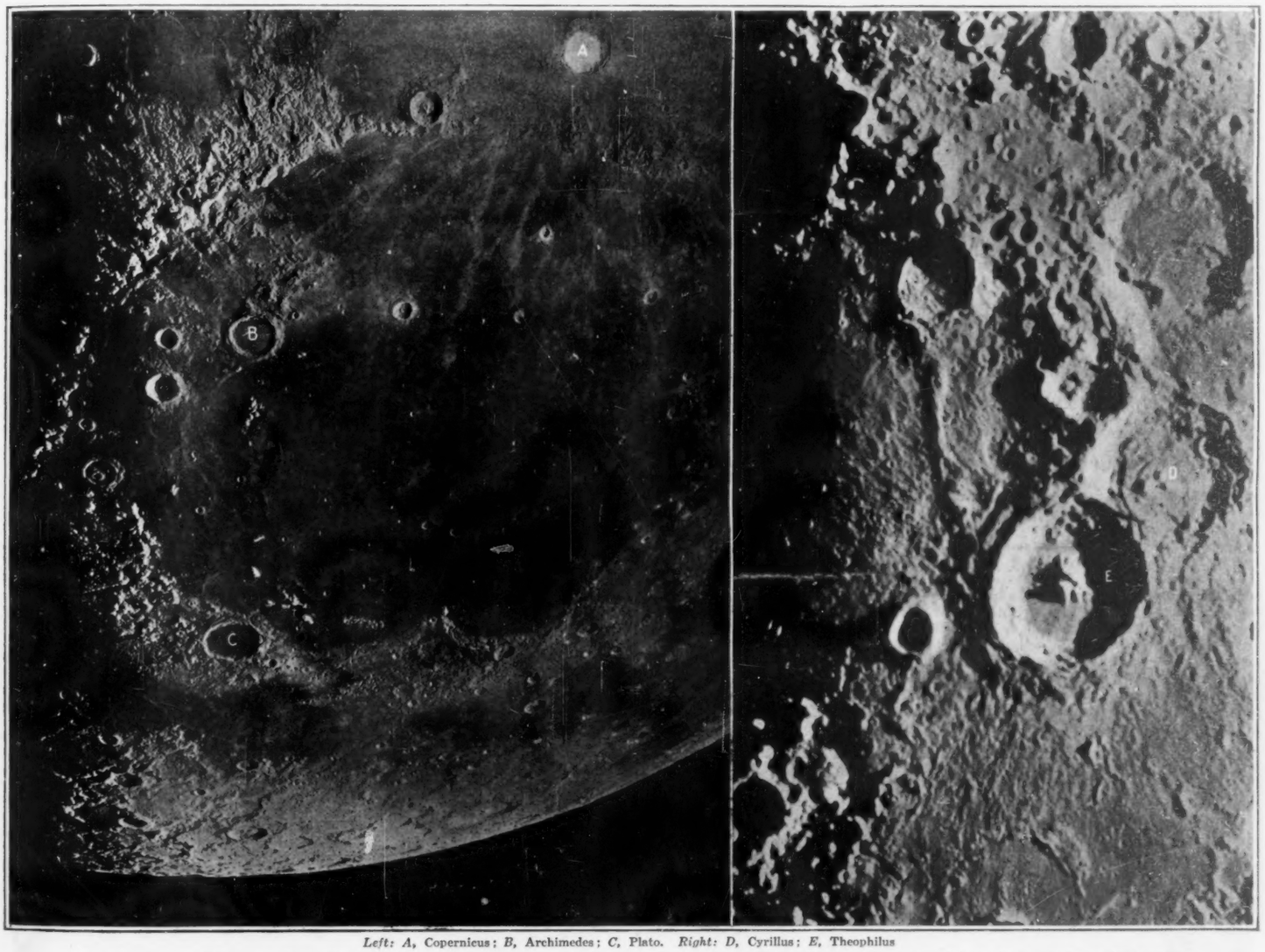
Now we have Maj. Ives and his craters of considerable size formed on Langley Field. He directs our attention to Copernicus, among others. This is one of the big fellows on the moon. There is the big circular depression with the surrounding ridge. The comparatively flat floor discloses several peaks rising from its surfce. In the neighborhood of Copernicus are several smaller craters, illustrative of depressions with and without a central peak. Archimedes and Plato are two other big lunar craters. They also have flat floors with surrounding rings. A comparison of these three craters with the cavities formed by impact on Langley Field will show similar features. We have the circular depression and the ring-like ridge. One of the crater floors shows what appear to be small peaks. The cause of the formation of these peaks may perhaps be attributed to some sort of a rebound. Lead bullets fired at a lead surface resulted in such peaks, in certain instances, at least. It seems that an early objection to the meteoric hypothesis centered on the difficulty in seeing how an impact would produce the small peaks. These have now been produced by dropping water, lead bullets, clay projectiles, and, last of all, military bombs. Whether, in the last case, they are due to material which was at first ejected from the depression but which later fell back, is not easy to say.

When a punch or similar instrument is forced to make an indentation in a metallic surface, a ridge forms all round the hole. This is doubtless explicable upon the general basis of the impenetrability of matter. The material forced in must cause other material to move, even after one makes allowance for a measure of compression. The locus of least resistance is the region surrounding the punch and lying close up to it. Upon the hypothesis of the formation of the lunar craters by meteoric impact, the surrounding ridges are doubtless to be explained along the lines employed in giving a reason for the ridge around the punch.

The formation of the peaks under the impact hypothesis would seem to be not so very easy of explanation. If they are the results of initial compression followed by release, one wonders what combination of circumstances brings about concentrations of this release at various points and particularly at the center of the main region of impact. If the meteoric face presented cavities, the peaks could be explained after the manner of the surrounding ridge. But why a central peak? The dropping of globules of water upon thin mud, however, did in fact produce cases of a peak in the centers of the depressions; so that, it would seem, impacts may produce central peaks whether we understand the process or not.

An objection has been brought against the impact hypothesis which enters upon the physical property of plasticity. At ordinary temperatures, there are numerous substances which will bend and otherwise deform upon the slow application of physical forces, which will nevertheless fracture or crumble if the force is applied quickly. Thus, a long rod of glass, if supported in a horizontal position at the two ends, will bend under its own weight with the passage of time. In the course of a year or two, even this brittle material will have undergone a very considerable deflection without fracture. Doubtless, almost any of the usual materials may be made to "flow" if the compelling forces act slowly enough; and it is probably just as true generally that the speed of action may be increased, provided the temperature is properly raised. Now a meteor striking is not a slow force and one is accordingly to expect fractures and crumbling effects rather than a flow. On the other hand, it generates heat by the transformation of the physical motion through the impact. It may very well be then that the motion and the temperature may be sufficiently related to account for the ridges, depressions and peaks on the lunar surface. Besides, may not there

(*Continued on page 499*)



Left: A, Copernicus; *B,* Archimedes; *C,* Plato. *Right: D,* Cyrillus; *E,* Theophilus

Two views, one of the moon's northern limb and the other of a smaller region, showing craters that could very well have been produced by impact

Cacti and Their Uses

A Discussion of This Interesting Family and Some of the Things It Is Good For

By Dr. William A. Murrill, New York Botanical Garden

Photographs by courtesy of the United States National Museum

A desert is not necessarily a monotonous waste

IT is estimated that there are three billion acres of desert land in the world; and, if these unattractive and unproductive wastes are ever to "blossom like the rose," it will be the cacti or plants similarly adapted to desert conditions that will furnish the flowers. Desert plants were like other plants once, but the vital necessity for preserving moisture gradually wrought a wonderful change in their appearance and structure. Few of the cacti now have any conspicuous leaves, their place being taken by flattened joints, or pads, which are modified portions of the stem; and even the sap has become mucilaginous or milky, preventing the loss of water to the hot, dry air by which these plants are continually surrounded. Spines of various shapes and sizes serve to protect them against grazing animals that are often killed when driven by hunger and thirst to devour these plants in spite of their spines. The few forms of spineless cacti that occur in the wild state always frequent rocky ledges and other situations that are inaccessible to most animals, if not to all.

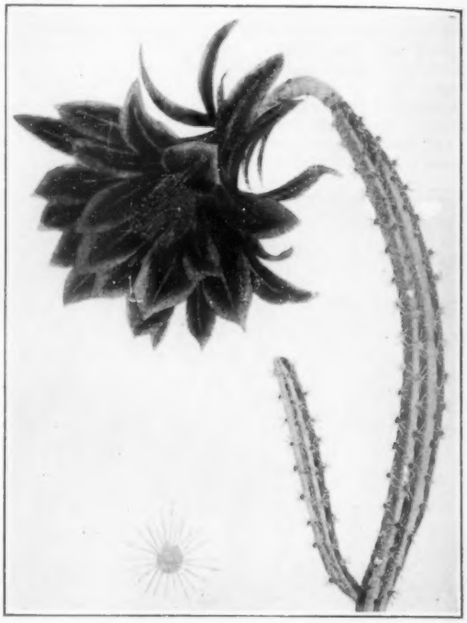
The number of species of cacti recognized is large, amounting to about one thousand, and half of these are found in Mexico. They vary from tiny plants no bigger than one's finger to trees sixty feet in height, presenting all manner of queer and interesting shapes and furnishing the botanist with no end of knotty problems. Extensive collections of living plants may be seen under glass at the New York Botanical Garden, the Department of Agriculture in Washington, and the Missouri Botanical Garden in St. Louis; while others in the open are to be found at Riverside, California; Tucson, Arizona; Mesilla Park, New Mexico; Laredo, Texas; Miami, Florida; and elsewhere.

Cactus plants are certainly not ornamental in the ordinary sense, but beauty is relative. A forest of giant cactus trees stretching mile after mile in the desert with nothing to rival them may be decidedly attractive. In Mexico the cactus ornaments the national banner and is stamped on many of the older coins, while in Arizona and New Mexico it has been selected as the state flower.

The cactus family is noted for the magnificence of its flowers, which are usually large, often fragrant, wide-spreading or tubular, diurnal or nocturnal, evanescent or persistent, and vary in color from white, yellow, or orange to rose-colored, deep-red, or purple. The calyx and corolla are not distinct, but the numerous stamens in the center are often differently colored and lend an added charm to the flower. The fruit is often brilliantly colored, highly ornamental as well as useful, and lasts for a long time.

The cactus plant has indirectly added much to the attractiveness of certain manufactured garments by supporting the cochineal insect, from which the famous cochineal dye is made. This insect occurs on a species of Opuntia, the cochineal fig, and its near relatives, along with other mites and scale-insects, but it is so minute and difficult to distinguish with the unaided eye that it was long thought to be the seed or bloom of the plant itself. Leeuwenhöck, in 1703, discovered that it was the female of an insect (*Coccus Cacti*), which never moved from a certain spot on the cactus, the male being the active member of the family but colorless and therefore useless. These insects are harvested three times during the dry season, being swept from the cacti into wide-mouthed bags with stiff brushes and killed in boiling water or hot ovens, after which they are dried in the sun and put up in small packages for the market. In this thoroughly dried condition 70,000 insects are required to make a pound.

The ornamental value of cacti, although important, is not uppermost in the mind of the average inhabitant of arid regions. The trunks furnish him material for



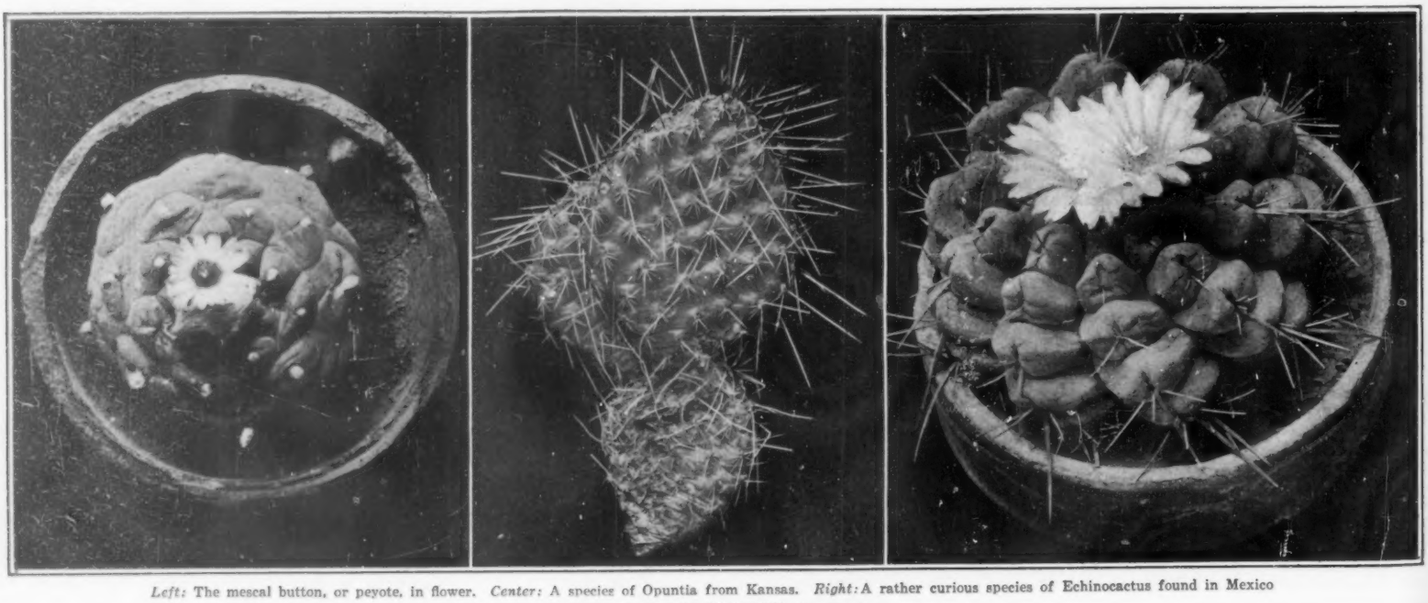
The splendid flower of Heliocereus Mallisoni

houses, corrals, firewood, etc., and, when planted close together they form hedges that are lasting and impervious. It is here behind a shield of thorns that the little cactus wren finds a refuge from hawks where she can build her nest and rear her young in safety.

The cactus trunk is composed of a woody axis, or skeleton, surrounded by pulp. From this skeleton table legs, chairs, napkin rings, canes, veneering, etc., are made. The spines also are useful, serving as needles, toothpicks and pins for mending leather or cloth. Some are curved and supply ready-made fish-hooks, while the straight ones are bound to slivers of bone to form very efficient barbs. One species of cactus bears fruits that resemble great chestnut burs, and these have been used by the Indians for ages as hair brushes.

The pulpy parts of the stems and fruits are highly valuable as food both for man and beast. The young

(*Continued on page 499*)



Left: The mescal button, or peyote, in flower. *Center:* A species of Opuntia from Kansas. *Right:* A rather curious species of Echinocactus found in Mexico

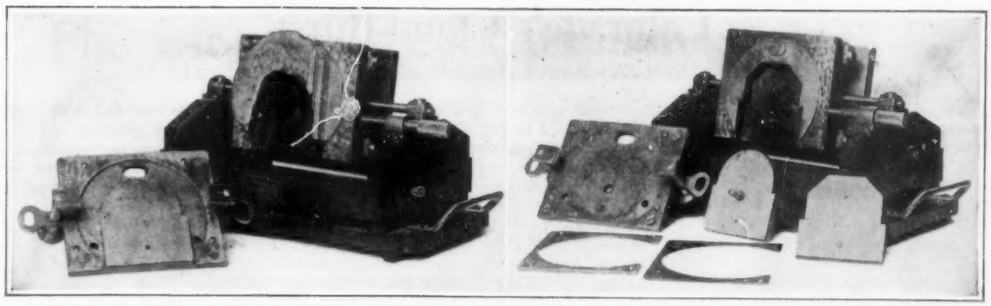
Several cacti of widely differing types

A Money-Saver in Locomotive Repair

EVERY steam locomotive carries from four to twenty-eight bearing boxes for the truck and driving wheels. Each of these boxes has a hubliner—a metal disk protecting the driving box from the friction of the wheel hub. This hubliner is ordinarily cast on from babbitt metal, by means of an operation that is difficult and dangerous for the machinist and inordinately costly to the railroad. The machinist has to raise the bearing box with a chain hoist and put it in a fire pot, where it must remain half an hour before becoming hot enough. When it attains this point it is again hoisted out of the fire and put on the floor, where a workman builds a wall inside and out of fire clay, large enough to cast on a two-inch liner. After some five hours the box has cooled sufficiently for it to be moved into the machine shop. Here the babbitt is shaved off to the proper thickness, the shavings falling to the floor and mixing with the iron and steel scraps which lie there, making necessary a separating process before the latter can be used. The babbitt scrap is waste pure and simple, since a second heating renders it second class metal. After this planing the box is carried to the locomotive erecting shop, where the necessary holes are drilled for assembling it on the engine—a difficult task, and one invariably resulting in loss of one or more drills. The entire process requires the services of five men and extends over two to three days.

A Newark, N. J., machinist has devised a hubliner mold that eliminates all this. It makes possible the installation of a hubliner within an hour and a half. No heating, soldering or fireclaying is required. The lubricating holes are cast direct in the liner, saving all drilling. The liner can be cast right on the cold box at the point where it is taken from the wheel, so there is no chain-hoisting or other moving of the work about. Although cast on the cold box without soldering, the inventor guarantees that the liner will not come off. He points out that when cast this way the liner has a "skin," which is not the case where it has to be shaved off; the period of renewal becomes a year instead of six months.

The apparatus by which all this improvement is attained is simple enough. Our photograph shows it after it has been taken down off the completed liner, which is seen as cast on the box. It will be at once understood how the pattern is clamped to the backpiece, and the latter turned over and clamped to the end of the box, preliminary to the casting. Patterns of various shapes and sizes may be used with the single back-piece to produce liners of any desired model.



Left: The old method, showing how much metal was wasted. *Right:* A hubliner cast on the box by the new process, and the mold disassembled beneath

The new outfit for casting locomotive hubliners at great saving of men and metal

Ornamental Typewriting

AT the time, a year ago last fall, when the editorial typewriters kept the SCIENTIFIC AMERICAN in the ring while most of our contemporaries were suspended because of the compositors' and pressmen's strike, none of our readers was more interested in our efforts than Mr. Jacob Backes, of this city. Mr. Backes has for some years been interested in the possibilities of photographic reproduction from typewritten copy as an alternative for type-set material; and he has written several articles explaining his ideas, and even gone so far as to induce the Century dictionary to recognize the name, callitypy, which he has given to his system. He boldly takes the bull by the horns in the matter of typewritten text, and insists that the only reason for having the lines come out with even words or syllables is convention; that it is just as sensible to carry a word over at any point. Accordingly the difficulties of justification, which we emphasized in our issue of December 13, 1919, do not exist for him—he runs merrily along, and moves over to the beginning of the next line whenever his copy brings him to the end of this line.

Mr. Backes has recently been experimenting a little further in the direction of typewritten copy, and he now finds that he can produce title lines of various degrees of fancifulness with the one machine. It will be recalled that when we were typewriting our issues we had a special machine for printing the main titles, and that we made subtitles and authors' lines by using the capital letters on two ordinary machines of slightly different type-face. Mr. Backes has found seven characters on the keyboard of his typewriter that can be dispensed with—we can count without any particular exercise of the imagination nine such characters on the machine which we are using at the moment, the very one, it so happens, that produced 95 per cent of our emergency issues of 1919. He has replaced these seven dispensables with seven arbitrary signs—a simple curved line in four positions, an upright of ordinary type thickness and one of solid black much thicker, and a diagonal line sloping backward. Taking these seven in conjunction with the ordinary hyphen, dash and diagonal fraction bar, he is able to execute a large variety of ornamental lettering. The series of SCIENTIFIC AMERICAN titles which he has turned out bear ample witness to this, and a careful examination of these will make it clear that Mr. Backes is justified in his claim that he has done no retouching or blocking out, and in fact no trick work whatever. So far as the handling of the machine is concerned, this copy is evidently straight typewriting, and the possibilities are doubtless considerably wider than this particular group of examples shows.

THE letters, ornaments and borders in the above illustration were produced by typewriting the characters \ ) (/ | _ \ | - combinationally end to end or over each other. The callitypic outlineals took the place of as many dispensable characters on the machine. Ordinary black record ribbon was used, no carbon sheets. All typing proceeded from left to right. There was no penwork, whiting out or soldering or mortising. No guiding device was used, and there was no shifting or reinsertion of the paper.

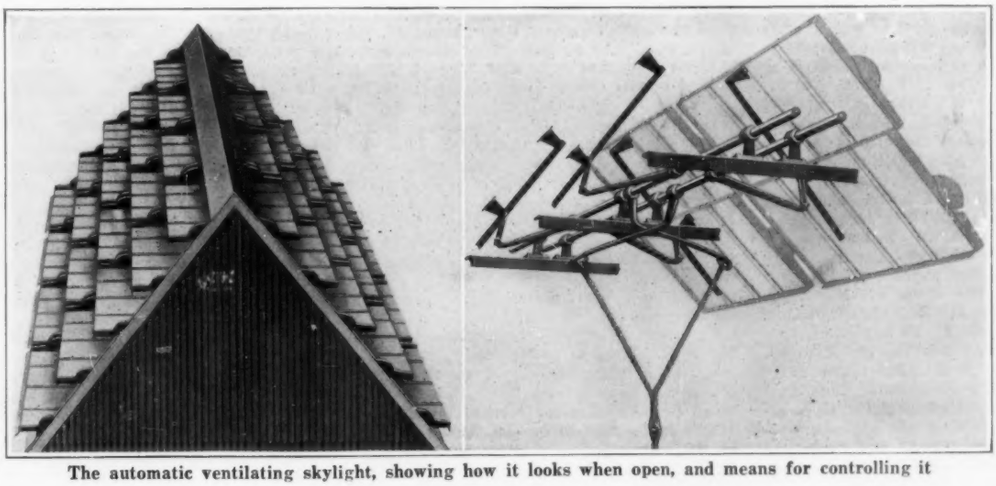
The original size of this callityped illustration was 8 1/5 by 7 inches. All originals can be either photographically enlarged or reduced to microscopic print.

A sample of what can be done with a typewriter equipped with a few special keys

A Weather-Proof Skylight Ventilator

SOMETHING different in skylights is the subject of the accompanying drawings—nothing less, in fact, than a skylight the entire area of which remains available for ventilation during any ordinary rain or snow storm. The skylight is self-opening when the control is released. This control may be by hand; or if it is desired that the skylight open as a means of release of smoke and fumes from fire, it may be held in closed position by a fusible link or an inflammable rope, to be automatically released when this gives way. The explanation that the new ventilator is designed largely for use in theaters explains what might otherwise be somewhat of a puzzle—why it is desired to give a fire exit to the outer air.

The construction is such that the device can be used as a lean-to ventilator and skylight, or placed in any other way. When closed, one sash overlaps the next by several inches, with a nosing at the top of the under sash to keep out any water that might be driven up by a rain storm.



The automatic ventilating skylight, showing how it looks when open, and means for controlling it

Colorado's Cloud-Burst

Some of the Causes and Results of the Pueblo Flood

THE flood which ravaged eastern Colorado beginning on the afternoon of Saturday, June 4th, is of considerable interest from the scientific viewpoint. The damage done, both to life and to property, was not so heavy as has been done by other floods. The Johnstown disaster that cost 2,209 lives will hardly be equaled by the Colorado floods; certainly no such toll as the 6,000 killed by the Galveston hurricane will in the present instance be exacted. The property loss will not reach the figure of $300,000,000 attained by the Miami flood of 1913—probably the most costly freak of the weather, so far as dollars and cents go, ever experienced in this country.

Yet the Colorado flood of 1921 will perhaps take front rank in disasters strictly comparable to it in cause. The Dayton catastrophe was hardly an "accident" at all—it was merely the annual rise always to be looked for in the Mississippi and its various tributaries, made higher than ever before by a combination of circumstances. The Johnstown flood was directly due to human failure—the water that engulfed the city was not that of a sudden storm or of a natural increase in the river, but simply that stored in the big dam when this broke. And the Galveston disaster was entirely different from all the others mentioned in that it was not the sequel of an over-burdened river at all, but was due to no other cause than the piling up upon the shore of the waters from the Gulf of Mexico, urged landward by continued high winds.

The water that descended upon Pueblo with so little warning, on the other hand, was neither a seasonal freshet nor primarily the store from behind a broken dam. To a degree seldom if ever before approached by a destructive flood it was entirely the proceeds of a single violent downpour of rain. The cloud-burst is not a common phenomenon—it occurs from time to time, and from place to place. The weather man knows very well what it is, but why it is he has not yet been able to state to his complete satisfaction. It is distinguished from cyclone, tornado, hurricane, etc., by the fact that the outstanding feature is precipitation rather than wind. We may have a perfectly good cloud-burst with practically no wind—at least, with practically no surface wind.

The name appears to be a relic of the time when the clouds were thought to be more or less substantial and continuous masses of water suspended, as such, in bulk over the earth; and when it was therefore possible to regard the sudden deluge of water as actually resulting from the "bursting" of such a mass—presumably much as a tire bursts when it blows out. These violent storms are local—so much so that they can often be sufficiently placed by reference to a single town. The chief difficulty in accounting for them lies in the fact that a great deal more water is precipitated by them than it would be possible for the entire atmosphere above their point of occurrence to hold, even at the point of absolute saturation. Moisture-laden currents must therefore be brought in from other localities, and the suddenness and violence of the typical cloud-burst suggests that several such currents are required. It also appears probable that the conditions for a cloud-burst involve an abnormally high temperature-altitude gradient, so that a comparatively slight rise of the air will result in a heavy drop in temperature and hence in the amount of water that the air can contain. In any event, it is clear that the cloud-burst involves the laying down, all at once and in one place, of moisture taken up by the air over a large area and a considerable time.

One who has not actually witnessed one of these affairs can have little conception of the violence with which it rains. "The skies opened" and "the rain came in sheets" are but feeble efforts at description. It is seldom that accurate measurement of these torrential downpours can be made. Nevertheless, the general statement is offered by General Greely, the explorer and meteorologist, that while two and one-half inches in 24 hours constitutes an exceptionally heavy rainfall, the cloud-burst attains a rate of precipitation of from five to eighteen inches of water per *hour*. In a word, a week's hard rain falls all at once.

There are two factors which, given a cloud-burst, determine the degree of damage. The water is there; it must be disposed of. It may be absorbed by the ground, and it may run off; other alternative there is not. The absorption depends upon the character of the soil. To be sure, under such a bombardment of water as is offered by a severe cloud-burst, almost any soil might get saturated; but a thick surface layer of sandy or stony soil passes water through to the lower strata with surprising swiftness, and can take care of a surprising proportion of the deluge. A dense, clayey cover, on the other hand, possesses very slight absorptive power to begin with, and as soon as this is used the clay soil is finished—it passes the water down through the ground with extreme slowness. Everybody has seen soil of this character, so impervious to water that it doesn't even form mud, but allows the fluid to stand much as it would on a concrete slab.

When the soil has absorbed what it can of a sudden downpour, the rest has to run off via the streams. If these possess reasonably high banks for a considerable distance below the point of the cloud-burst all is well. It is difficult to imagine, for instance, a destructive flood along the Delaware River from Port Jervis to the Water Gap. The surface of the stream could rise vertically twenty feet or more with practically no damage—even the river road is higher above the water than that, and the houses and villages are higher yet. One would as soon expect the Colorado to overflow the banks of the Grand Canyon and flood the plains of Arizona, as the Delaware to do any material damage in this part of its course. But all rivers do not flow through gorges and deep valleys. The rivers that enter the Mississippi from the west in particular are of a sort not easily visualized by one accustomed to streams like the Delaware and the Hudson, the Susquehanna and the Connecticut, the Merrimac and the Penobscot. It is hardly any exaggeration to say that the Platte and the Arkansas, the Red and the Canadian, flow across the flat surface of the prairie, rather than in depressed beds. A Nebraskan would laugh at the easterner who might refer to the "valley" of the Platte. A rise of a few feet in these streams involves a lateral spread out of all proportion to the vertical increase.

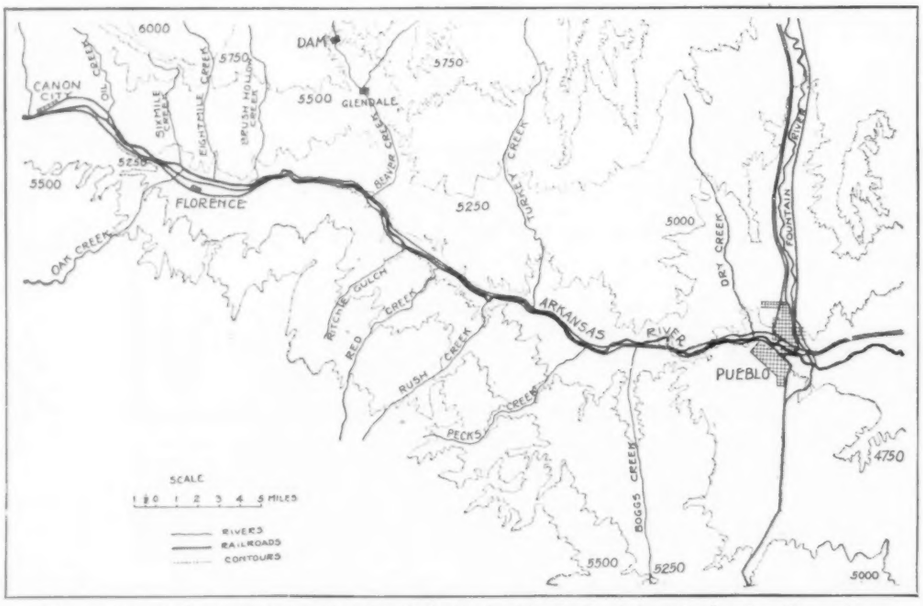
This is the sort of stream that was asked to carry off the water of a particularly severe cloud-burst. Through the Royal Gorge, just west of the left-hand edge of our map, the Arkansas is a regular mountain stream—the Gorge is 2,600 feet deep and might with good reason be called a canyon, as is attested by the name of the town at its mouth—Canyon City. But as we go downstream from this point, the banks become less and less steep and recede farther and farther from the stream. By the time we come to Pueblo, we have, at the south, low bluffs a mile or so from the river, with a flat between that is little if any above the level of ordinary high water. At the north there is not even the bluff—the flat is wider, and shades off almost imperceptibly into the hills.

On top of this the entire area covered by the rainfall has a surface of rock or of hard, impermeable clay. It is little exaggeration to say that every drop of water that fell had to make its way to the streams. The cloud-burst appears to have been in the mountains north of the Arkansas, and to have been one of exceptional severity. The various creeks that are shown emptying into the river from the north appear to have moderately high banks. This means that when asked to carry off a volume of water many times their capacity, they are able to meet the demand. Instead of spreading all over the surrounding territory, and then receding gradually over a period of days, they rise ten, twenty, thirty feet or even more, increase their rate of flow, and fill their gorges with a raging torrent of flood water. No damage is done because nobody to speak of lives along such a creek in the first place, and those who do live along it have their shanties at a reasonable elevation above the water.

In the case of the present flood, there was another and a man-made complication. Along several of the creeks that run into the Arkansas there are dams, behind which are reservoirs with considerable storage capacities. The one on Beaver Creek at the point indicated on the map burst, and to the already swollen waters of the creek was added the contents of the reservoir.

It had been raining rather steadily all over Colorado for some days, and the creeks were at a very liberal stage to begin with; so was the Arkansas River. The Fountain River, which rises not far from Denver and, in its southward course, receives tributaries mostly from the west, draining the Pike's Peak section, was likewise pretty full. The cloud-burst sent a wall of water many feet in height down Beaver Creek and many of the other streams flowing into the Arkansas and the Fountain. This is another expression which we are more accustomed to meeting in fiction than in fact, but which does no injustice to the facts. A sudden flood in one of these rock-bound creeks produces a wall of water rushing down the stream, just as truly as the bursting of the Johnstown dam released such a wall. If only one of these creeks were to discharge its flood into the Arkansas, the excess water could be taken care of. But there were more than one, and the entire drainage system of the country already held the full volume of water that it is designed by nature to care for. If the rate of flow attained by the narrow and steep creeks could be maintained in the rivers, the problem of disposing of the water would come close to solving itself. But the broader and more gently sloping river is of necessity a stagnant pool, in comparison with the creek; excellent illustration of this is seen in the fact that as late as Tuesday afternoon, 72 hours after the flood was in Pueblo, its crest had reached no farther than Syracuse, Kan., only twenty miles over the state line. In a broad river with slight downstream slope it is actually easier for the water to pile up and spill off sideways, and to back up behind the sluggish crest of the flood, than for it to flow away down the channel.

(*Continued on page 500*)



The section of the Arkansas valley in which the Pueblo flood originated, showing the contour of the land and the location of railroads and chief towns

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

The Farm Market for Trucks

IF one is to know what the immediate possibilities are for the motor truck on the farm he must know what farmers all over the country think about farm trucks. The opinions of four thousand eight hundred and ninety-eight farmers scattered all over the United States are now available. This information was collected by the truck-tire department of a prominent Akron tire concern, and we are able to pass it on to our readers through the courtesy of B. M. Pettit, who compiled the figures.

Seventeen per cent of the four thousand eight hundred and ninety-eight farmers answering Mr. Pettit's questions use trucks on their farms, the other eighty-three per cent use horses. Of the farmers not using trucks, forty-four per cent have considered buying them. To quote from the report:

"We want to be conservative in the interpretation of these figures, so, in order to be ultra-safe let's assume that this investigation represents not the attitude of the total number of 6,700,000 farmers in this country but rather the attitude of the upper third or about two million farmers. When we say forty-four per cent of the farmers have considered buying trucks, that automatically builds up in our mind possible sales within a reasonable time to forty-four per cent of two million, practically eight hundred thousand farmers.

"It is worth while to notice that the reply is fairly uniform from all farmers in the terms of the acreages which they cultivate. We find that thirty-nine per cent of those replying from farms of one hundred acres or less are considering buying trucks; forty per cent of those from farms of one hundred and one to one hundred and sixty acres; forty-six per cent from farms of one hundred sixty-one to two hundred and forty; and fifty-two per cent from farms over two hundred and forty acres. We also notice the same general interest in the truck in the dairying as in the fruit belt, and in the grain field as in the livestock field. In other words, neither

(*Continued on page 500*)

How the Long Island truck farmer hauls produce to the New York market in a rapid and economical manner in large trucks

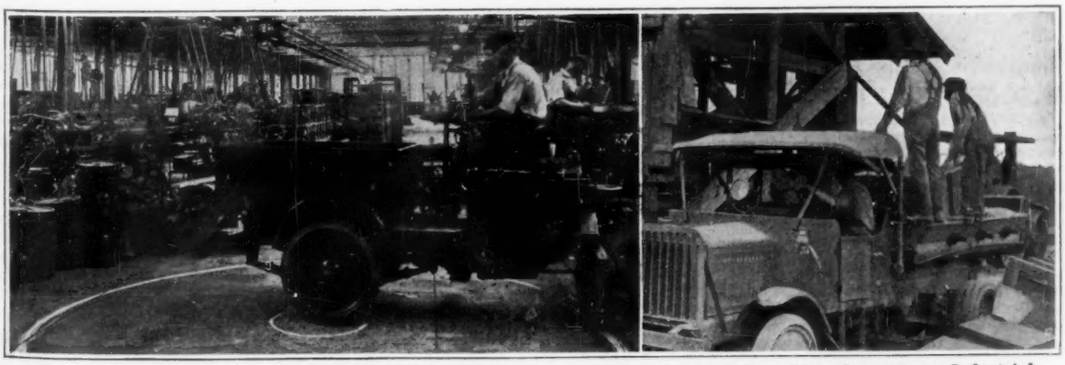
Labor-Saving Truck Bodies

THE ingenuity of the modern transportation engineer is constantly taxed to devise new means of utilizing the motor truck advantageously, in cutting down the cost of transporting various materials. Most motor trucks of any pretentions now have a power take-off device fitted to the transmission so that the engine power can be used for performing other work besides propelling the truck. The brick-carrying body illustrated is a good example of a special mechanism designed for carrying on a definite duty more economically than the conventional truck construction would permit. As will be seen from the cut showing the body in the load-dumping position it is composed of a box-like steel carrying-member attached to two tubular supports one on each side of the chassis, as shown. Cables run over pul-

(*Continued on page 500*)

Brick-carrying body in dumping position

A 2½-ton truck equipped with log-carrying apparatus which makes it possible for one man to load and unload logs



Left: **Short turning radius of an industrial truck-tractor demonstrated in aisle of machine shop.** ***Right:*** **Industrial truck-tractor with dumping body used in construction work, receiving a charge of concrete from mixer**

The Industrial Truck-Tractor

MENTION has previously been made of a special form of small motor truck propelled by a gasoline engine and intended for industrial use. Its ease of control and compactness are well shown in accompanying photograph, showing it at work in the plant of an automobile manufacturer. The truck-tractor is flexible, has a short turning radius, is built so low to the ground, and is so powerful that it can be used for many purposes such as carrying a full ton load of shavings from the lathe, foundry sand, red hot forgings or castings, finished or unfinished parts from one machine to another or between plants. It will operate on rough roads as well as on factory floors. It will plow through snow or mud, through foundry sand or run on oil-sodden floors. Its ability to operate 24 hours a day without being laid up for recharging gives a positive advantage over electric trucks and its economical operation, coupled with the lack of breakage, makes this machine an exceptionally efficient and satisfactory one for many commercial purposes. Having nine and one-half inches of ground clearance and an abundance of power it can be run on rough ground, foundry floors, factory yards and bad roads. Its range of speed, one-half mile to 15 miles per hour, permits it to run slowly through congested places and around sharp corners, deliver its load exactly in the place desired without danger to machinery or employees, and to run at high speed through open places and in the traffic of roads and city streets.

One of the machines was recently driven from Buchanan, Michigan, to Chicago, Illinois. This machine was stopped at several of the large industrial plants on the way and most interesting demonstrations were held. It covered a distance of 143 miles in one day and arrived in Chicago in excellent condition, ready to begin regular routing work in one of the well-known institutions.

The fact that this machine is built entirely of metal and that its center of gravity is very low, makes it a most satisfactory one for foundry and forge shop use. Extreme changes in temperature do not affect its operation. Hot casting and forgings can be carried from one section of the plant to the other—quickly and without damage to the machine. It can also be used to advantage in contracting and building operations as another photograph shows.

Recently Patented Inventions

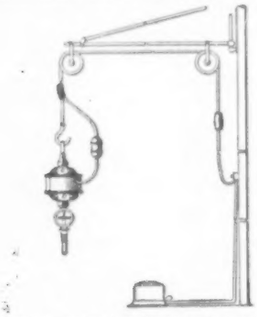
Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Aeronautics

RADIO AERIAL TORPEDO.—G. J. DYE, Dothan, Ala. This invention relates to apparatus designed especially for offensive operations in warfare; it has particular reference to an aerial device or machine adapted to be directed through the air to any desired elevation or distance, carrying a charge of high explosive and driven by its own power, while the direction of movement thereof is controlled by wireless apparatus from the sending station which may be either stationary or located on any suitable moving carrier, such as a battleship or aircraft.

Electrical Devices

PORTABLE MOTOR.—J. A. ANDERSON, 310½ Chickasha Ave., Chickasha, Okla. The invention relates to portable motors such as are used in connection with dental engines, portable fans and the like, and particularly



SHOWING A STANDARD FORM OF DENTAL ENGINE BRACKET AND MOTOR

to a suspension bracket whereby a motor can be suspended from any suitable support to actuate devices of various characters. The motor is relatively small to permit of its free movement from place to place.

Of General Interest

DUSTPAN.—I. M. FREEMAN, address R. G. Patterson, 1111 W. 15th St., Oklahoma City, Okla. The object of this invention is to provide a pan, made from a single sheet of metal, cut to shape and bent to form an integral structure, and having a detachable handle pivoted thereto and a detachable rest, for engagement by the foot to hold the pan in place. The pans are so shaped that they may be nested for shipment or storage in order to economize room.

CUE TIP HOLDER.—H. J. GRENIER, c/o Mrs. Jacobs, 40 Grassmere Ave., Fairfield, Conn. More particularly the invention relates to the construction of cue and tip, and means for removably securing the tip to the cue, an object being to provide a device which permits of the tip being removed and replaced as desired, the operation being extremely simple, and the construction strong and durable in use.

FIREARM.—W. E. ROSEBUSH, c/o Inland Empire Paper Co., Millwood, Wash. The invention relates to recoil operated breech loading hand firearms. The object is to provide means in automatic hand firearms of the concealed hammer type whereby the hammer can be securely locked when in cocked position and the sear rendered inoperative relative to the trigger. Another object is to visually indicate whether the hammer is in fired position and not in cocked position.

HEEL FASTENER.—L. CERF, 49 Maiden Lane, New York, N. Y. The object of this invention is to provide a heel fastener arranged to permit the manufacturer or repairer to quickly and securely fasten a heel on footwear or to conveniently remove a defective heel and replace it by another. The device is simple and durable in construction and inexpensive to manufacture.

Hardware and Tools

STOVE LID.—W. SCHARFHAUSEN, 321 Rear 1st Ave., Salt Lake City, Utah. This invention has for its object to provide a lid of the character specified, wherein means is provided in connection with the lid for supplying steam to the fire box, above the burning fuel, in quantities such as to insure conservative and efficient combustion of the fuel.

GRAPPLER.—J. C. GINTER, Box 1737, Breckenridge, Texas. The invention relates to a grapple for regaining tools which may be submerged. The principal aim is to provide a grapple having a tool receiving socket provided with means for gripping the tool and also with means for directing the tool into the socket. The device is reliable, efficient and cheap to manufacture.

Heating and Lighting

DRYING KILN.—S. E. CORNISH, 2636 Etna St., Berkeley, Cal. An object of the invention is to provide a drying kiln having means for moving material longitudinally therein and means for compelling a continuous circulation of air from the dry end of the kiln to the charging end of the kiln and in such movement compel the air to pass crosswise or transversely through the kiln any desired number of times.

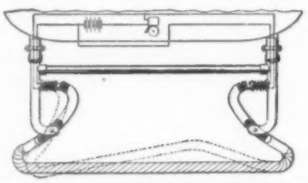
Machines and Mechanical Devices

BINDING MACHINE.—A. E. CRANSTON, 639 Peyton Bldg., Spokane, Wash. The invention relates to bundling machines for securing the parts comprised in a box or barrel into bundles. It is a purpose to provide a binding machine which is semi-automatic for use in small factories where it is not desired to incur the expense of installing a wholly automatic machine, or for use in larger factories where it can be employed as an auxiliary.

SHEET FEEDING.—C. WINKLER, Berne, Switzerland. This invention relates to a device for lifting separate sheets of paper from a pile by means of suction and blowing nozzles. When a sheet has been raised by the suction nozzles, the connection of the nozzles with the air pressure is cut off, and nozzles of a horizontally extended section begin to blow air under the sheet, so that this sheet is completely separated from the pile.

Pertaining to Vehicles

OBSTRUCTION ALARM.—M. ROSENBERG, 1228 Pacific St., Brooklyn, N. Y. This invention relates to safety attachments for automobiles or other vehicles. Among the objects is to provide means whereby when the vehicle is being maneuvered in close or crowded positions such as in garages, or parking places,



A PLAN VIEW INDICATING AN ALARM CIRCUIT

the driver is enabled to devote practically all his attention to the controlling devices of the machine and hence is relieved to a large extent from attending to the conditions located especially at the rear of the vehicle.

Designs

DESIGN FOR A DISH OR SIMILAR RECEPTACLE.—F. PFEIFFER, SR., 1542 Gates Ave., Brooklyn, N. Y.

DESIGN FOR A BUTTON.—J. FOX, 49 W. 24th St., New York, N. Y.

DESIGN FOR A RING.—M. ROSSEIN, 17 W. 45th St., New York, N. Y.

DESIGN FOR A SIGN.—F. W. WILSON, 49 Maurice Ave., Elmhurst, L. I., N. Y.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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What Is the Trouble with the Railroads?

(Continued from page 484)

volume of traffic, the fact that there is not a large volume to move, the next logical step is to ascertain why freight is nonexistent. To take up in detail the manifold reasons for the absence of traffic would be entirely beyond the scope of the present inquiry. But there is one alleged reason which it is pertinent to examine; and that is the assertion, heard with increasing frequency, that the Nation's business is stagnating because freight rates are prohibitive. Like many other delusions, this can be dispelled by a brief investigation.

In the first place freight rates are not high, absolutely or relatively, by any standard of measurement. The average revenue per ton mile is actually less now than it was before the Interstate Commerce Commission was established. In 1887, the year the Interstate Commerce Commission was organized, when the purchasing power of the dollar was much higher than it is now, the average revenue per ton mile for all the railroads was 1.6 cents. There was a steady decline until 1916 when the average receipts for hauling one ton of freight one mile was 7.7 mills. That is to say in order to earn money enough to buy a 2-cent postage stamp the railroads had to haul an average ton of freight a trifle more than two and a half miles. American freight rates were much lower than in any other country in the world.

From 1916 freight rates gradually increased until January, 1921, when the average was 1.21 cents per ton per mile.

Relatively to the price of other commodities railroad freight rates lagged consistently behind and are still bringing up the rear. Taking both freight rates and the index number of wholesale prices as computed by the Bureau of Statistics of the Department of Labor in 1913 as 100, it will be found that rates did not increase but actually decreased to 99 in 1916, returning to 100 in 1917. In 1918 rates increased to 118 but by that time the index number of wholesale prices had soared to 196. The wholesale price index number attained its maximum at 243 in 1920 while freight rates lagged 97 points behind at 146. Up to January, 1921, the swift decline in the wholesale index number and a moderate increase, followed by a decline in freight rates have brought the two within 11 points of parity, the index number of wholesale prices being 177, freight rates 166. In other words, freight rates are still lower than other commodities, comparatively speaking, just as they always have been.

Perhaps this point can be made more impressive by a few specific examples. The reason most commonly alleged for the present extravagant retail prices of fresh fruits and vegetables is the increased freight rates which, of course, must be paid by the consumer; so the examples may well be based on these most familiar products.

On April 16, 1921, the average price paid producers for Texas cabbage was $7 a ton. Freight charges to Chicago, including icing, for cabbage must be shipped in refrigerator cars, and the Federal tax on freight revenues amounted to $26.30 a ton. Total to farmer and railroad $33.30 a ton, or 1.67 cents a pound. On the same date cabbage retailed in Chicago at 7 cents a pound or $140 a ton, which was $106.70 a ton more than farmer and railroad combined received. Spinach on the same date yielded the grower $5 a ton; freight to Chicago was $30.36; total, $35.36. On the same date spinach retailed in Chicago at 15 cents a pound, or $300 a ton, or $264.44 more than both producer and railroad received. On the same date onions were $42 a ton in Texas; freight to Chicago was $29.64. Onions then retailed at 10 cents a pound in Chicago, or $128.36 a ton more than producer and railroad received.

So vociferous were complaints that high freight rates were interfering with the movement of fruits and vegetables from Florida to Eastern markets that Chairman Clark of the Interstate Commerce Commission investigated the matter. He found that shipments of these commodities from Florida from November 1, 1919, to March 1, 1920, were 26,886 carloads; for the corresponding period of 1920-1921 they were 28,420, an increase of 1,534 carloads. On this showing it would appear that the present freight rates can hardly be blamed for the unsatisfactory condition of the railroads.

In opening the inquiry by the Senate Committee on Interstate Commerce, May 10, Chairman Cummins read into the record statistics showing that while operating revenues have very greatly increased since 1913 expenses have increased still more with the result that net operating income for all the railroads for the year ending March 1, 1921, was only $2,578,922 as compared with $787,610,435 in 1913. As spokesman for the railroads, Julius Kruttschnitt, Chairman of the Southern Pacific, explained the practical wiping out of net revenues by saying that increased labor charges since 1916 aggregated $2,225,000,000; and that expenses over which the railroads had no control, because of prices fixed by the government or by general market conditions covered 97.5 cents of every dollar of operating expenses in 1920.

Meanwhile the mileage of railroads abandoned in 1920 exceeded the mileage built for the fourth consecutive year. From 1917 to 1920, both inclusive, 4,032 miles of railroad have been abandoned and only 2,700 miles have been built, so that there is an actual decrease of 1,332 miles of railroad in the four years. Only 1,998 locomotives were ordered in 1920 as compared with the high record of 6,265 in 1905 and an average of 2,060 for the five years from 1915 to 1919, inclusive. Only 84,207 freight cars were ordered in 1920 as compared with the high mark of 341,315 in 1905, and an average of 101,776 for the five years from 1915 to 1919. In other words, the task of providing an increase in transportation facilities adequate to insure the healthy economic growth of the Nation is not being performed.

From this it would appear that something very serious, indeed, is the matter with the railroads.

The Storm King Road

(Continued from page 485)

change, especially in details. One of the variations was the elimination of a bridge having a span of 200 feet. Another was the substitution of a cut for a tunnel. The cut was an expensive one and also difficult. It was feared, however, that the dip of the strata might result in precipitating the roof and wall into the tunnel excavation, since the rock is rather treacherous at this point. These are a couple of variations and rank among the larger ones. Sometimes it was found advisable to shift the location a bit to right or left. It is very probable that it has been wise to permit minor variations. The plans were executed without adequate information as to details, and presumably they had to be so executed.

The road is, for a considerable part, at a level varying from 250 to 400 feet above the river. This level is very precipitous, especially round the front of Storm King. The double track of the West Shore Railway lies at the foot of the mountain and close to the river. Of course, the railway had to be protected. Detached masses of rock and boulders were lying around everywhere. Some of these masses were of considerable size, overall dimensions running up to 10 x 15 x 25 feet. The boulders weighed up to 25 tons each. These had to be disposed of in some way. They were drilled and blasted into smaller

sizes. This work had to be done with great care, particularly the blasting. Too much explosive, and the track below might be put temporarily out of commission by the fall of loose rock; too little explosive, and the boulder or big rock would not split. There was, in fact, excellent opportunity for the display of skill and judgment. Often the fragments were carefully lifted and then placed where their position guaranteed safety below. Effort was made to start with a narrow ledge, and to blast the cliff from this. The fragments would be kept on the ledge until they could safely be removed or else put into retaining walls or the like. A big wooden barrier was constructed at one point for the protection of the railway track. It was located at one side of the track and its duty was to prevent falling rocks from bounding from their points of impact on to the railway. It was built not unlike a fence, and was made some 20 feet high and 140 feet long. Vertical posts were located at intervals of 4 feet and to these were spiked 2-inch planking. Braces, etc., were put in place to make all secure. And, nevertheless, some of the rocks broke through. Not far from this same location a blast was set off at a level about 300 feet above the track. A big fragment, weighing some 600 pounds, was hurled 1,200 feet horizontally out from the mountain side and struck fair and square on top of a telegraph pole.

The retaining walls are sometimes small and insignificant; and sometimes they are from 20 to 50 feet high. Necessarily they had to stand upon solid footings. It was sometimes necessary to go down to levels 10 or 20 feet below the surface in order to locate the footing properly.

When the Storm King Road is finished it will surely rank among the most notable in the world. The difficulty of construction and the wonderful beauty and picturesqueness of the view combine to make the new highway a remarkable addition to the valley of the Hudson, already famed in the annals of the New World.

Controlling the Lower Mississippi

(*Continued from page 485*)

to the extent of $773,613,600 in value was imported and exported during the eleven months ending May 31, 1920; and New Orleans takes her place as second port in America.

Levees are built 10, 13 or 16 feet high. On the river side the slope is one in three; on the land side it varies from one in four to one in ten. The width of the crown averages from 8 to 10 feet, sometimes much wider, as for instance, at Canal Street, New Orleans, at a drop of from 5 to 8 feet on the land side, there is built a banquette or berme which varies from 20 to 40 feet, according to the height of the levee. In Louisiana about 65 per cent of the levees are built with the aid of power-driven machinery; about 30 per cent by scrapers drawn by mules; about 5 per cent by men with wheelbarrows. The cost of work performed by machinery is 21½ cents per cubic yard; by mules with scrapers, 46 cents; and by men with barrows, 31.05 cents. Allowance made for settling or shrinkage of levee is 25 per cent of net fill, for work done by machinery; 15 per cent for scraper work; and 20 per cent for wagon work. The Levee Districts, the State Board of Louisiana and the United States Government have built about 18 miles of new levees in Louisiana during the past two years. Together with enlargement of levees, the work done covers about 10,500,000 cubic yards at cost of about $2,250,000. But the progress has not been so rapid as desired, because of scarcity and cost of labor and materials brought about by the Great War.

Much encouragement toward local activity has been given by the passage by Congress in 1917 of the Flood Control Act. This act, in general terms, "comprehends the extension, improvement and maintenance

NEW BOOKS, ETC.

THE AIRPLANE. By Frederick Bedell, Ph.D. New York: D. Van Nostrand Company, 1920. 8vo.; 257 pp.; illustrated.

Part of the material of this volume is a revision of the author's well-known "Airplane Characteristics" and "The Propeller." As a whole, the re-written text and the seven new chapters constitute a practical handbook for flyer, designer, and general reader. His students, many of them returned service men, have given of the fruits of their experience, and valuable suggestions by the manufacturers of aircraft are embodied in the volume.

SECRETS OF EARTH AND SEA. By Sir Ray Lankester, K.C.B., F.R.S. New York: The Macmillan Company, 1920. 8vo.; 243 pp.; illustrated.

What is the oldest picture in the world? It is etched on a deer's antler, and is much better than most of the "new art." Sir Ray shows us this, and at the same time takes a fling at Kipling's ethnology. He tells us of the origin of the swastika, of ancient monsters, of Vesuvius, of animalcules, and of many other curious things, and all in that "easy chair" manner of his which has endeared him to so many avid readers. He can find the marrow in dry bones and serve it up as a tidbit, and from extinct monsters he provides an intellectual repast.

POWDERED COAL AS A FUEL. By C. F. Herington, M.E. New York: D. Van Nostrand Company, 1920. 8vo.; 338 pp.; 124 illustrations.

In the industrial world more and more consideration is being accorded to the claims of this form of fuel; municipal lighting and power plants are using it after close investigation and experiment. This second edition of a treatise by an author in intimate touch with actual accomplishment incorporates his more recent studies of what he calls a "really marvelous fuel," cites the wide uses to which it may be put, and compares erection and operation costs with those of plants utilizing other fuels. These tabulations indicate a great economy and efficiency in favor of pulverized coal.

THE DAY OF THE CRESCENT. By G. E. Hubbard. London: Cambridge University Press, 1920. New York: The Macmillan Co. 8vo.; 243 pp.; 16 plates.

These glimpses of Old Turkey, when her empire was swollen with pride, satisfy our longing for the exotic and picturesque and at the same time cast new light upon the history and character of a warlike people. Old forgotten travel books have been resurrected and diligently searched for true atmosphere. From the barbaric Tartar to the Grand Turke himself, a multitude of actors play their parts in the fascinating setting, and ancient woodcuts are reproduced to bring the scenes vividly before the eyes.

CINEMA CRAFTSMANSHIP. A Book for Photoplaywrights. By Francis Taylor Patterson. New York: Harcourt, Brace and Howe. 8vo.; 277 pp.

The author, instructor of photoplay composition in Columbia University, gives the writer of scenarios a glimpse of the whole art and science of production, tells him how to shape his scenario, and leads him through the mechanical processes from manuscript to finished picture. The book includes a complete photoplay exactly as written, and appeals not only to the writer, but also to the general reader who is sufficiently interested in moving pictures to wish to understand the steps in their progress from brain to screen.

HISTORICAL FICTION CHRONOLOGICALLY AND HISTORICALLY RELATED. By James R. Kaye, Ph.D. Chicago: Snowdon Publishing Co., 1920. 8vo.; 748 pp.; fully indexed.

We have waited a long time for this book, which fits historical fiction into history and keeps the gears in mesh one with the other. We have very often wished to read books of historical fiction but have been deterred by lack of knowledge of the period and whether the characterization would be "true to history." Of course there are some authors that always ring clear as a bell, like Charlotte M. Yonge, Georg Ebers, Ernst Eckstein or Charles Kingsley. Others we hardly hear of now, as Grace Aguilar, Manzoni, Harriet Martineau, Jane Porter and others. To assemble such a galaxy of writers and novels as Dr. Kaye has done is a monumental task which has been performed with extraordinary judgment. We are used to "Standard Opera Plots," "Songs Every Child Should Know," and so on, and now we have a thoroughly sound book with which all cultivated people should be familiar. A careful index satisfies the most critical demands. Look up Jane Porter for example. We find under "The Scottish Chiefs" that she was born at Durham in 1776, that she knew Sir Walter Scott, and that she inspired him to write "Waverley." We find that "The Scottish Chiefs" contains historical inaccuracies. Thus forewarned we get a succinct account of the book and its plot. "Thaddeus of Warsaw," Miss Porter's other book, is similarly treated. This is one of hundreds of examples. Every private as well as public library should have this book on its shelves.

THE THERMIONIC VACUUM TUBE AND ITS APPLICATIONS. By H. J. Van der Bijl, M.A., Ph.D. New York: McGraw-Hill Book Company, 1920. 8vo.; 391 pp.; illustrated.

The passage of electrons through high vacua, as exhibited in thermionic tubes, discloses numerous functions that are rapidly being utilized in engineering fields and have already given rise to a large volume of literature describing the application of thermionics to practical problems. This new work develops the principles of operation and coördinates the phenomena encountered. The exposition is sufficiently elementary to take its place in the college laboratory, first acquainting the student with the properties and behavior of electrons, then leading up by easy stages to the more significant applications of the device.

AIRCRAFT AND AUTOMOBILE MATERIALS OF CONSTRUCTION. Vol. I., Ferrous Materials. By Arthur W. Judge. New York: Isaac Pitman and Sons, 1920. 8vo.; 739 pp.; 275 illustrations; 200 tables.

Manufacturers, designers and students may turn to this work with confidence; it contains the gist of many specialized books supplemented by modern data and by information from the records of societies. The volume concerns itself with the composition, strength, properties and treatment of metals; the relationships between the critical and actual properties; stresses and strains; and test; the machines and instruments used in testing are the subject of a separate section. Tabular matter covers the properties of the carbon and alloy steels used industrially, and furnaces and pyrometry are rather fully discussed from the works engineer's and constructor's viewpoints. The usefulness of the exposition is of course not limited to aircraft and automobile manufacturers, but extends itself to all users of ferrous materials.

LONDON DAYS, A BOOK OF REMINISCENCES. By Arthur Warren. Published by Little, Brown and Company: Boston, 1920. 285 pp.; 12vo.

The author is an American journalist of distinction, who for an extended period in the 80's and 90's was London correspondent for and later editor of the *Boston Herald*. Mr. Warren has a rare gift of pen portraiture and a keen analytical faculty and his London experience brought him into close touch with the leading men of that period. To the scientific reader, the most interesting chapter is the one devoted to Lord Kelvin. Mr. Warren gives us a picture of him: "He sat on the lower stair near the front door of his house making difficult calculations and strange diagrams in a little book bound in green morocco. It would be five minutes before the carriage started, so out came the memorandum book which he always carried in his coat pocket, and he sat on the stair and worked." He was seventy then, but his spirits were as young as those of the youngest of his students. Says the author: "There was never such a man as he for asking questions. . . . Whatever your profession, trade, interests in life, he would put questions that went to the roots of your matter." Said he one day in a talk in his study: "Patience, great patience is the need of this generation. It asks results before it earns them."

COMMERCIAL AIRSHIPS. By H. B. Pratt, M.I.N.A., Chief Engineer, Airship Department, Vickers, Ltd., with an introduction by Commander Sir A. Travor Dawson, Bart., R.N. Published by Thomas Nelson and Sons, Ltd., London, Edinburgh, and New York. 8vo.; 235 pp.

The author of this valuable work tells us that with the exception of purely historical works, there is a dearth of books in the English language dealing solely with airships, and that in view of this, he has included some chapters on airship design and construction in his book. The work opens with a chapter on the evolution of the airship. We learn that an Austrian, Schwartz, first attempted the construction of the rigid airship and built one of 130,000 cubic feet capacity with a framework of aluminum covered with aluminum sheeting which formed the gas container. It was the first ship to be fitted with a petrol motor, one of twelve horsepower. The first practicable airships were built by the engineer Juillot in conjunction with the Labaudy brothers. The French were thus the pioneers. Inspired by the work of Schwartz in '97, followed by that of the Labaudy brothers, Count Zeppelin developed and completed his first great ship. Excellent chapters are those entitled "Commercial Possibilities," "The Airship as a Means of Transport," and "Commercial Uses of the Airship." There is a chapter on possible transport routes and service, followed by one on proposed types of commercial airships. Then follow a study of airship stations, airdromes, et cetera; a chapter on the costs of maintenance; one on handling and navigating; and, finally, chapters on the structure, propulsion, interior arrangements, et cetera. A most valuable appendix is the log of the outward voyage of "R-34," the first airship to cross the Atlantic. The book is very richly illustrated with half-tones of the various types of ships, views of the interior and accommodations of passenger ships, and some excellent constructional photographs. It is also replete with charts, diagrams and line drawings, showing the main structural features of the completed ships.

EUROPE, 1789-1920. By Edward Raymond Turner, Ph.D. Garden City, N. Y.: Doubleday, Page and Company, 1920. 8vo.; 687 pp.; 32 maps.

The French revolution and the Great War are hail and farewell to a tremendous epoch—and epic—of European history, a spectacle the outward incidents of which have been recorded over and over, yet too often as isolated scenes, too rarely as prophetic promises and warnings. Professor Turner has striven to see this epoch whole, to follow the linked causes and effects, and at the same time to stir the mind to further thought and interpretation. The result is a gratifying measure of success, and a work that should be sought eagerly not only by colleges but also by the reading public. It conveys an insight into the true significance of events, a sense as of climbing heights to see the panorama of the past outspread beneath our feet.

THE PLEASURES OF COLLECTING. By Gardner Teall. New York: The Century Company. 8vo.; 328 pp.; illustrated.

When you stumble upon an Old Curiosity Shop, do you feel an irresistible desire to peep in upon its "world of yesterday"? Most people have something in them which responds to this call. Mr. Teall's shop is well stocked with American, European and Oriental antiques, and he conducts you from one object to another with such infectious enthusiasm, such sympathetic understanding, that a corner of the mantle of his authority falls upon the hearer's shoulders; china and chintz and pewter, glass and Wedgwood and Sévres, take on new meanings for him; both collector and general reader will retain the memory of a pleasurable and profitable hour.

MODERN WELDING METHODS. By Victor W. Pagé, M.S.A.E. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 292 pp.; illustrated.

Those familiar with the comprehension and clarity this author brings to his instructional texts on the automobile and airplane will not need to be told that in this treatise on the art of joining metals we have a compilation of authoritative data and a manual of the best practice that is at once complete, up to date, and understandable to the mechanic and practical man. Here are full descriptions of the oxy-acetylene welding and cutting torch; the spot, butt and are systems of electric welding; and the Goldschmidt thermit process; with helpful notes on forge welding, brazing and soldering, and the heat treatment of steal. Formulas and methods are plainly set down, and specially made engravings illuminate nearly every page of the text.

GOIN' FISHIN'. By Dixie Carroll, Cincinnati: Stewart and Kidd Company, 1920. 8vo.; 355 pp.; illustrated.

Like to go fishin' with the editor of *The National Sportsman?* Then here is your chance. As you tramp the outlands and whip the streams with him, he tells you weather and feed facts, talks of fresh-water game fish, and explains the use of natural and artificial baits. And he doesn't mind using the vernacular. Yet his pungent conversation brings out the poetry of forest and stream and puts nature into your blood and many angling secrets into your brain. "Where to Go-a-Fishing" lists numerous good localities in Wisconsin, Minnesota, the north Pacific coast region, and Canada. Major General Leonard Wood writes an introductory appreciation that strikes the keynote of the book.

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nance, under the coöperative support and activities of the United States, the States and the several Levee Districts of the States bordering on the Mississippi River, of the lines of public levees upon which the basins contiguous to the river, subject to overflow, are dependent for protection; and the promotion of such auxiliary works (bank protection, etc.), as may be necessary to aid in the control of the river and to effect and maintain dependable navigation." The length of the river so to be treated is about 1,579 miles, extending from Rock Island, Ill., to the Head of the Passes at the mouth of the river in Louisiana, "presenting a field of activities more extensive and exhaustive than has at any time in the past ever been at all contemplated or thought possible."

Within the past year 10,000 cubic yards of levee have been placed at one wharf in New Orleans; another section of levee in the lower part of the city with an extent of 7,000 feet has been enlarged in such a manner that the crown has a width varying from 10 feet to as much as 45 feet. The levees along the Navigation Canal, which is a new and great undertaking, connecting the waters of the Mississippi River and Lake Pontchartrain, will have a 10-foot crown, a canal slope of one in three, and a land slope of one in three and one in five.

Facts About Concrete

(Continued from page 486)

other ingredient used for the batch.

In confirmation of this, tests have developed that when 20 per cent more water is used than needful for maximum strength, the resulting strength of the concrete will be diminished substantially 30 per cent; while if a 30 per cent excess of water is employed the possible strength of the concrete will be cut down 50 per cent. Apart from impairing the strength of the concrete and seriously affecting its capacity to resist wear or abrasive action, the surplus water virtually entails a waste of cement, for excess water leads to the same reduction in strength that would follow if two or three pounds of cement were omitted. Therefore, for the sake of economy and the realization of the best results, only the smallest quantity of water should be used that will produce a workable mixture.

In this connection, the Bureau of Standards has determined that much can be gained by seeing to it that dry rather than wet aggregates be utilized in preparing concrete. (The term "aggregates" refers to sand, gravel, and broken stone—sand being called "fine" and the gravel and stone being spoken of as "coarse.") The Government experts state that wet aggregates, when these are proportioned by volume measure, as is so commonly the practice, require anywhere from one-half to one bag more of cement per cubic yard of concrete than do dry aggregates. Therefore, the wetness of the sand should be neutralized by increasing the quantity of that ingredient while reducing the amount of gravel accordingly—adding only the normal measure of cement. Indeed, contrary to general belief, the U. S. Bureau of Standards has shown that with an "over-sanded" mix and fewer pounds of cement per cubic yard, a concrete was obtained which, at the end of twenty-eight days, possessed a 26 per cent higher compressive strength than a batch composed of the customary amounts of cement, broken stone, and sand—the latter being wet in both cases.

In the choice of the fine aggregate, preference should be given to smooth sands rather than to those commonly described as sharp, because less water is needed to produce a workable mixture; and, again, the coarser sand can be manipulated easier with a smaller measure of water than fine sand. But above everything, it is of the utmost importance that the sand be clean and free of humus or vegetable matter. These organic impurities are apt to affect seriously the ultimate strength of the concrete. A simple test has been devised that makes it practicable to detect quickly the presence of these weakening factors, even though they may not be visible. If sand, by weight, be vitiated by one-thousandth part of organic impurities, the strength of the concrete will be diminished nearly 25 per cent. This is a warning to people given to using any likely looking sand that may be available.

And now we come to one of the paradoxes in this matter of producing a concrete that will prove strong and wear well in service. Today, concrete is extensively employed in the construction of floors, loading platforms, pavements, etc., calling for sturdiness and also a notable capacity to resist abrasion. While it is desirable to use only enough water to produce a plastic mixture, nevertheless it is indispensable that there be sufficient water to bring about the proper hydration of the cement. Otherwise, if the concrete dry out too rapidly and the curing conditions be not favorable the material will be deficient in strength. It seems that the proper curing of concrete is second in importance to the control of the water content. That is to say, the concrete must have as much water as possible during the time it is setting and hardening. Therefore, in order to arrest premature drying, and to prolong evaporation for ten days or more, the concrete should be covered with damp sand or earth or protected by wet burlap. Treatment of this description may make all of the difference between an ultimate compressive strength of 1,300 pounds per square inch and 4,850 pounds per square inch.

Properly compounded concrete grows stronger with age; and a barrier of concrete 2 inches thick will show a water penetration of only half an inch after exposure for 24 hours to a hydrostatic pressure of 60 pounds, while limestone and sandstone of substantially the same thicknesses will reveal penetration through and through in the course of anywhere from 10 seconds to about 20 minutes. The time given to the mixing of cement is vital to ultimate strength; and where this is done by machine the mixing should continue for at least a minute instead of for a maximum of 40 seconds, which is the general practice. Finally, investigation has established that many coarse aggregates heretofore deemed unfit for working into concrete can be used without hesitation and with excellent results if they be added in approved proportions.

Regardless of the amount of water employed in a batch care should be taken that the water is not extremely alkaline nor charged with organic matter. Water may be used at temperatures ranging from the freezing to the boiling point, without producing any effect, but hot water is recommended in cold weather to make certain of ridding the aggregate of frost. From what has been said it should be clear that the man of research has placed concreting upon an entirely new plane, and he has demonstrated that the combining materials impose conditions in their choice and handling in order to insure the most satisfactory results.

If newly cast or laid concrete be kept warm and moist operations may be carried on during the cold months. If the surfaces of reinforcing metal be clean and free of oxide the concrete will grip the steel and make an intimate bond. And then, if the fresh concrete be mechanically tamped or subjected to pressure, thus compacting the mass and squeezing out water, the material will be the better and stronger for this treatment. Whatever may have been the opinion as to the value of concrete for the building of highways, the fact is established that from now on we must recognize its superior merit. The concrete road is low in upkeep, offers the same surface in hot or cold weather, and requires a good deal

LEGAL NOTICES

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

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less tractive effort than any other type of prevailing roadbed. Concrete structures will stand up under fire where stone buildings would be apt to succumb; and experiments have been made which reveal that gravel concrete columns can be rendered further immune to flame by coating them with plasters composed of gypsum, hydrated lime, and kieselguhr. And bitter experience has emphasized that the round concrete column is better able to endure intense heat or a blaze than one that is rectangular in section. In brief, a great deal has been learned latterly about concrete, and yet the investigator is busy seeking further enlightenment. The quest for knowledge is for the purpose of widening the ways in which concrete can be used confidently—eliminating the while the hit-or-miss methods of the past.

Making the Airplane Fireproof

(*Continued from page 487*)

vents the fire from entering the helmet. A small window of two thicknesses of 1/8-inch mica with 1/4-inch air space is provided. The suit proper is made of 1/4-inch sheet asbestos with a 3/8-inch inner lining of hair felt. Both shoes and gloves are made of the same material as the suit. The weight of the suit with the helmet is 15 pounds, but with a few refinements this could be brought down to about 10 pounds.

Because of the fireproof nature of an airplane treated by his process, Mr. Bradley has gone a step further and equipped aircraft with fireworks and flares for exhibition purposes. The wings, struts, turtle back, tail and other parts of a fireproofed plane are covered with fireworks, and under the fuselage a dozen huge flares are mounted, all being wired for battery ignition, so that the pressing of a button by the pilot sets off all the fireworks and flares at one time. The effect at night is, obviously, most spectacular—and absolutely safe, according to the inventor.

The Craters of the Moon

(*Continued from page 491*)

be a good deal of fractured and crumbled material in the ridges and peaks?

The bombs dropped on Langley Field were all of them moving at a much less speed than a representative meteoric body. Meteors are understood to enter the earth's atmosphere at velocities ranging, generally, between 10 and 40 miles per second. Such a body striking the moon's surface with its velocity unimpaired because of the absence of a substantial atmosphere would, Maj. Ives calculates, if all the heat generated be retained in the meteor, produce a temperature of 270,000° F. This temperature would gasify all known materials, even if nine-tenths of it were dissipated into the materials surrounding the meteor; so that finally we should have an explosion. A military bomb will, accordingly, be a better experimental substitute for a meteor than non-explosive objects. In common with the objects used in early experiments, the bomb generates but little heat in the surroundings at the moment of impact; but, in contrast to them, it does imitate the explosive effects. The calculation of the temperature produced was based upon the minimum speed of 10 miles per second. The higher velocities would naturally produce still more excessive temperatures. One reaches the conclusion, then, that meteors behave upon impact much as do military bombs—that is, they give rise to an explosion.

The ability of a bomb to produce the central peak in a depression is shown very markedly in our third photograph. This is perhaps a more pronounced case than any on the moon itself. But the holes made on Langley Field are of all descriptions. Thus we have the extreme case of a crater floor free of projections, except perhaps close up at the foot of the circular cliff.

In our final picture we have the lunar craters Theophilus and Cyrillus, the one overlapping the other. A similar instance on Langley Field is shown in the second view of page 490.

In conclusion, one may say that the new evidence tends to rehabilitate the impact hypothesis; and that we still have a formidable alternative to the volcanic idea, notwithstanding Professor Pickering's vigorous handling of the subject in favor of the latter, in his work on *The Moon*, published before this evidence from Langley Field was in existence.

Cacti and Their Uses

(*Continued from page 492*)

pads, or joints, may be cut into strips and cooked like string beans, or boiled as greens, or stewed like okra, or fried like eggplant, or pickled, or made into sweetmeats like citron. "Tuna cheese" is made from the fruits of certain cacti, while the juice of red fruits is often used in coloring ices, jellies, and candies, and even in water-color painting.

The traveler who "knows how" need never lack for water where there are cacti. He may cut off the top of a barrel-cactus, pound up the pulp and squeeze the water from it into his drinking cup. He will find it slightly salty and bitter, but clear and rather palatable. Or he may support a cactus trunk on stones, build a fire under each end, and make a hole in the middle, from which the water will gradually trickle.

The Indian traveler also uses the milky juice of Mamillaria for healing cracks in his feet or for internal complaints when on long journeys. One of the most curious and interesting of the cacti is the "mescal button," or "peyote," which is a strong stimulant and allays all hunger and thirst and fatigue for the time being. The Tarahumare Indians and Huicholes of Mexico make a cult of the "peyote," going on long pilgrimages in search of it and employing it both medicinally and religiously as a cure for all bodily ills and a powerful aid to abstinence.

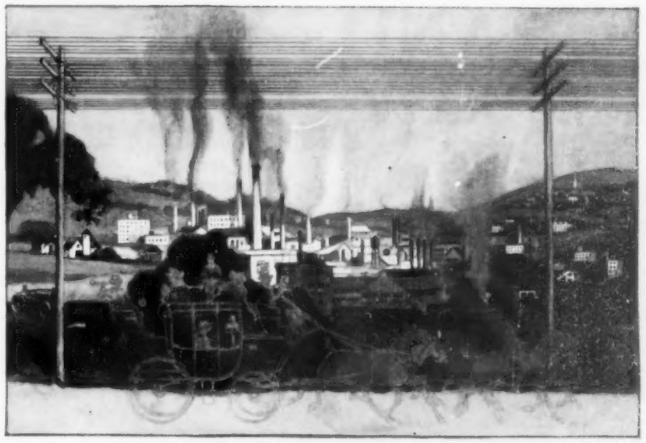
In certain parts of Mexico, Sicily and elsewhere, the natives live almost entirely on fresh cactus fruits when they are in season. They grow them in gardens and orchards and often gather them at dawn when they are coolest, although their temperature is always below that of the surrounding air. They are also used in salads, preserves, pickled with lemons, dried, fermented as a beverage, made into a syrup called "tuna honey," a thin paste called "melcocha," or a thick paste similar to guava jelly. Even the seeds are sometimes dried and saved to use when the fruits are gone.

The Barbados gooseberry, used for tarts and sauces in the West Indies, is apple-shaped and decorated with small leaves or bracts. The plant, *Pereskia aculeata*, is a straggling shrub with slender branches, recurved prickles, glossy-green leaves, and clusters of pale-yellow bowers.

The prickly pears, or tunas, are abundant and much used. They are pear-shaped or globular, weighing from an ounce to a pound; red, yellow, or purple in color; and usually sweet, though sometimes acid in flavor. The skin contains clusters of tiny spicules, or glochidia, which are very irritating if taken into the mouth, so that care is required in peeling them. They are sometimes called Indian figs or Barbary figs because of the numerous small seeds which they contain. Several species of Opuntia are cultivated for their fruits as well as for their edible joints. The flowers are large, usually yellow or orange, rarely rose or red.

Delicious fruits are those of *Cereus pitahaya* and its relatives. This species grows to the height of sixty feet and its trunk reaches two and a half feet in diameter. The fruit is gathered at dawn with long reed sticks armed with several prongs.

The fruits of *Cereus giganteus*, a handsome cactus of the Southwest, are also much esteemed either in the fresh state or preserved. They are egg-shaped, two or three inches long, green on the outside and



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From Charles Dickens' Preface to Pickwick Papers.

The Advance of Understanding

Even romance of sixty brief years ago could not imagine the great advance heralded by the passing of the stage coach. The railway and telegraph were coming into their own; but the telephone had not been so much as dreamed about.

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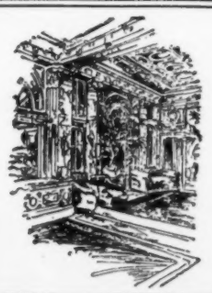

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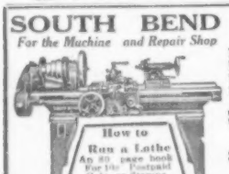

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crimson within. The strawberry pear, obtained from *Cereus triangularis*, is pear-shaped, bright-red, with slightly acid pulp, making it desirable in the fresh condition or as an ingredient of the "pepper pot" of the West Indies. Excellent fruits are also produced by *Lemaireocereus thurberi* and certain other large tree-cacti, and these "pitahayas" do not have the annoying prickles found in the fruits of Opuntia.

"Garambullas" are the small currant-like fruits of Myrtillocactus. They are eaten fresh or dried like raisins. The melon cacti produce a number of small edible fruits resembling tiny scarlet radishes or red peppers. The Mexican strawberry, found on a species of hedgehog cactus, is salmon-colored, two inches in length, and very sweet in flavor. It gets its name from its numerous minute seeds. Tetezo figs, so important to the natives of southern Puebla, are the fruits of a species of Pachycereus.

Although may of the wild cacti furnish valuable food for man and beast, it must be admitted that there is room for improvement both in the quantity and the quality of this food. I have visited Mr. Burbank's experimental grounds in California and fully realize the difficulty of his task in dealing with the cacti and the importance of his results. His problem was to take a vagrant, forbidding plant, and divest it of its thorns and prickles, breed out its indigestible woody skeleton and improve the size and flavor of its fruits.

Of the twenty or more genera in the cacti he selected opuntia because it was widely distributed, readily adaptable to soil and climate, hardy, thrifty, with edible pads and fruits, and already represented by some spineless varieties. He secured 75 species and 600 varieties of this genus from all parts of the world and selected from them plants that appeared to possess the greatest number of good qualities. Seeds from these plants were sown by the thousands and the new plants hybridized in order to break up their fixed habits. Gradually a few plants were obtained by crossing and selection that were spineless. After obtaining and fixing one good quality, he sought another and another, until, after ten years of very exacting labor, he gave to the world his "spineless cacti."

A number of these spineless forms, obtained from Mr. Burbank may be seen growing in the conservatories of the New York Botanical Garden. Some are especially suitable for feeding cattle, while others bear delicious fruits. Before the cuttings will grow they must be wilted in the hot sun for a week or more, after which they are partly buried in soil or ashes. When planted out in fields or orchards, they should be set three or four feet apart in rows eight or ten feet apart.

The fruits of these Burbank creations are over three inches long, usually yellow or red in color, and have flavors all their own, resembling those of peaches, melons, pineapples, etc. The amount of sugar is large, being 12 to 16 per cent which gives the fruits their sweetness and much of their food value. They may be sold for the price of oranges and it costs only half as much to grow them, while there need be no fear of a poor or failing crop. The food value of the spineless pads for stock is about half that of alfalfa, and enormous crops can be grown without irrigation on arid or sterile land unsuited to other crops.

Colorado's Cloud-Burst

(*Continued from page 494*)

Pueblo, situated at the confluence of the Fountain and the Arkansas Rivers, got the full benefit of the flood in both streams.

The map on page 494 shows the part of the Arkansas drainage system in which the flood had its origin. The contour lines are drawn for intervals of 250 feet. They indicate the great difference in relief between the Arkansas on the one hand and its tributaries on the other. Without cluttering the map up with so many lines as to make it unintelligible we found it impossible to do more than suggest the facts that the banks of these creeks are likewise steeper than those of the main stream, and that the latter is really bordered, below Turkey Creek, by a very considerable alluvial plain little higher than the water. We have been able to locate approximately one of the dams that broke; but the Geological Survey maps, the source for this as well as for practically all commercial maps of the United States or parts thereof, antedate the dams; so we are not able to show all of these.

Floods are nothing new to this region. Heavy rainfalls are common in the mountains, and it is a frequent occurrence to find the Arkansas occupying more or less of the broad flat space between its normal banks and the foothills at either side. The extreme severity of the present visitation is due to the fact that many days of unusual rainfall were followed by the cloud-burst and the going out of the dams. The damage may be roughly divided under three heads. Most of the loss of life was in the low parts of Pueblo, which were completely inundated, many houses being swept off their foundations by the unexpected rush of the water before their occupants could make a move toward safety. Then the floor of the river valley, as it gradually widens from the mouth of the canyon to Pueblo and beyond, is occupied by farms, which have suffered a great deal of damage to their standing crops as well as to their buildings. Finally, the railroads, building as they must along the line of the streams, have had much of their track swept away, while there has apparently been some loss of life from trains that were overtaken by the flood and swept from the tracks.

The floods at Denver and other points in the northern part of the state appear to be due entirely to the gradual rise of the streams under the influence of many days of rather steady, heavy rain. We read of no cloud-bursts in this section, and of no dams going out. This is the reason why the floods here, while severe enough, have not approached those at Pueblo and other points in the Arkansas River drainage system. But the Platte, which will eventually receive the flood waters from the northern part of Colorado, has even less of a real channel or valley where it passes through Nebraska than has the Arkansas through Kansas; so we may look for more serious secondary effects here than in the case of the Pueblo floods.

The Farm Market for Trucks

(*Continued from page 495*)

the size of the farm nor the type of farming has any monopoly on the interest in trucks.

"We believe we know fairly well why some farmers have bought trucks, but what about those who have not bought trucks? We want to know if this negative is a permanent one; if they are not buying trucks, is there any possibility of showing them the real economy of this kind of hauling? With this in mind, we find thirty-three per cent of the farmers give as a reason for not buying trucks some reason that is classified as 'Financial.' We find eleven per cent give bad roads and, incidentally, that is somewhat lower than we anticipated. We find that of those who say that they do not have the cash or credit with which to buy motor power for transportation, sixty-two per cent own automobiles and eighteen per cent own tractors. In other words, they have actually paid out money for the purchase of motor power in some of its phases, but are not as yet sold on the fact that this is applicable to the transportation of their crops, though they recognize the value of the same kind of power for personal transportation or for use in plowing and harvesting the crops.

"Of the farmers using trucks, forty-two per cent are using tractors. Here we find that the truck and tractor are not competitors as the smaller farmer is a less extensive user of the tractor than the larger farmer, while the truck is equally applicable to all sizes of farms. The size of the truck best suited to farm use is a subject of much discussion among truck manufacturers and salesmen as well as farmers.

"Regardless of the size of the farm, there is relatively little interest in a truck of less than one ton. We find from the report a very marked interest by those who have not yet bought trucks, in the one-ton trucks, in the ton-and-a-half and two-ton trucks. If we take this by the size of the farm, for example, we find forty-one per cent of them with farms of one hundred acres and less are interested in the one-ton truck. Of those farming over two hundred and forty acres, twenty-two per cent of them are interested in the one-ton truck, while only one per cent are interested in a truck of less than one ton. We find in the larger acreages thirty-nine per cent are interested in the two-ton truck, while twenty-six per cent of the farmers farming less than one hundred acres are interested in a two-ton truck."

Labor-Saving Truck Bodies

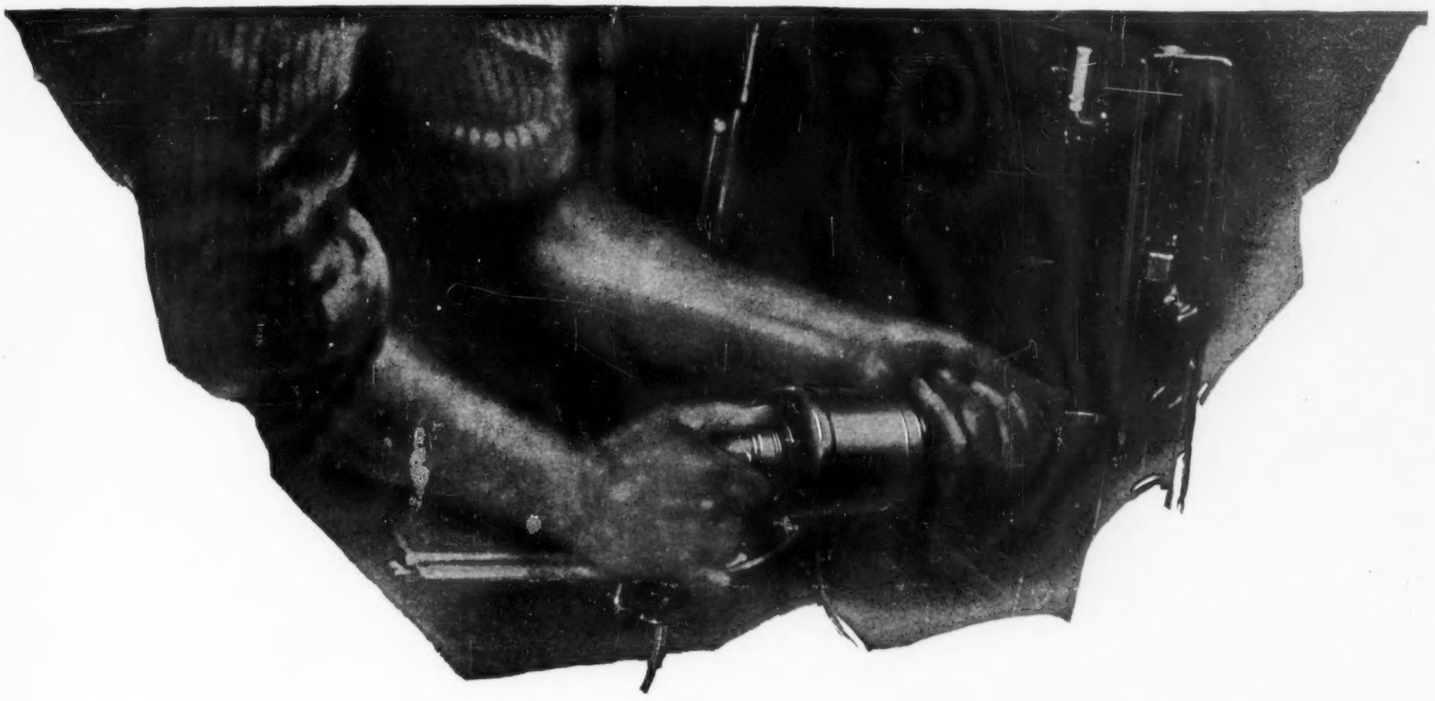
(*Continued from page 495*)

leys at each end of the tubular support, these cables being operated by means of gearing from the power take-off of the transmission. When the body is carrying a load of brick it rests in a horizontal position and the actuating member attached to the body frame is down at the lower end of the tubular support near the large sheave. When it is desired to dump a load of brick the engine power is diverted to the cross-shaft carrying the two large pulleys over which the cable runs, and as these pulleys rotate the body-actuating carriers are moved out on the tubular supports and the body is shifted from the horizontal position it normally occupies to the angular position necessary to dump its load. The construction outlined makes it possible to clear the rear end of the chassis with the body and have it assume a nearly vertical position so that the bricks may be deposited on the ground in the same orderly way in which they were loaded into the truck body.

Another use of the power take-off is outlined in the photograph of the 2½-ton truck which is equipped with a special log loader which makes it possible for one man to load or unload large logs unaided, except for the engine power, that would require a gang of men to handle with the simple skid equipment ordinarily provided for lumbering operations. The log-loading mechanism is very simple. It consists of a windlass roll carried at the side of the chassis by suitable bearings and extending from the cab to the rear end. The log to be loaded is encircled by a chain, the end of which is attached to one of the hooks on the windlass. When the engine power is diverted to the windlass-operating gear by the simple foot-pedal control, mounted on one of the steps, the chains roll up and drag the logs up the skidway and on to the truck frame.

Another simple device which saves considerable time is fitted to a truck of the Kansas City, Mo., Telephone Company. This truck is equipped with a simple hoist or derrick for raising and setting telephone poles. Recently the truck and a gang of three men, one of whom was the truck driver, made a record of setting forty poles in one hour. The holes had been dug and the poles distributed before the feat was attempted. It is stated that before this truck equipment was put into service it required six men to raise and set eight poles an hour. The truck is not only useful in general construction work, such as installing pole lines, but it is also valuable for drawing cables through conduits and for general emergency wagon work.

The increasing use of electric motors in industry and home is a broad field for the inventor's genius and the machine manufacturer's workshop



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